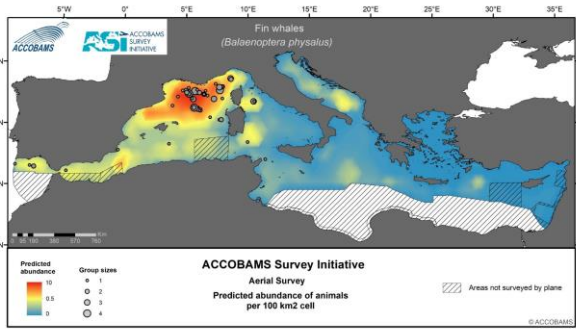
Estimates of abundance and distribution of cetaceans, marine mega-fauna and marine litter in the Mediterranean Sea from 2018-2019 surveys



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EXECUTIVE SUMMARY

Measuring the abundance and distribution of organisms is necessary to inform and implement conservation actions and to evaluate the effects of management (Grand *et al.*, 2007). This is especially true in the Mediterranean and Black Seas, where overall human impacts are high (Micheli *et al.*, 2013a; Halpern *et al.*, 2015, 2019; Stock *et al.*, 2018) and where cetacean populations are threatened as a direct consequence of these impacts (Notarbartolo di Sciara, 2016). In this setting, maintaining good conservation status requires prioritisation and implementation of effective actions and monitoring of their effectiveness (Micheli *et al.*, 2013b).

In recognizing the need for robust data on the conservation status of cetacean populations in the Mediterranean ecosystem, the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS) proposed a synoptic survey of the entire Region, the ACCOBAMS Survey Initiative (hereafter 'ASI'). Initially developed to improve knowledge of cetaceans in the ACCOBAMS Area, such a programme has been also deemed crucial to fulfil European Union (EU) Regulations and Directives, specifically the Habitats Directive and the Marine Strategy Framework Directive (Authier *et al.*, 2017), as well as other relevant instruments, including, but not limited to, the "Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean" of the Barcelona Convention, the "Convention on the Conservation of Migratory Species and Wild Animals" (also known as CMS or Bonn Convention), and the "Berne Convention on the Conservation of European Wildlife and Natural Habitats".

The ASI project, launched at the Sixth Meeting of the Parties to ACCOBAMS (Monaco, 22-25 November 2016), aims to establish an integrated, collaborative and coordinated monitoring system of the status of cetacean populations across the ACCOBAMS area, and to ultimately strengthen the conservation effort and governance for cetacean species in the Region. Developed and implemented by the ACCOBAMS Permanent Secretariat, in coordination and with the support of Mediterranean riparian countries and local scientists, the ASI is an unprecedented effort and a first step to assess cetacean abundance and distribution in such a diverse, heterogeneous and geopolitically complex Region.

Visual line-transect distance sampling aerial surveys covered 77% of the Mediterranean Sea and were complemented by ship-based visual and acoustic distance sampling surveys, to maximise survey effort, area coverage and the likelihood to monitor all the relevant Mediterranean habitats and the species therein. Given the known limitations of aerial surveys to monitor rare or elusive species (e.g., Dawson *et al.*, 2008), vessel-based surveys were focussed on those areas known or expected to be important for deep-diving species (sperm whales and beaked whales), as well as to survey those areas for which it was not possible to carry out aerial surveys.

The aerial component of the ASI was carried out between June and August 2018. The survey blocks were specifically designed for this component, considering previous knowledge of cetacean distribution, national airspaces, geopolitical situations and security constraints. While a full temporal overlap was originally planned with the vessel-based survey, due to the particular situation in some Southern Mediterranean countries for which it took more time to set up the surveys in their waters, the aerial surveys overlapped only in parts – both spatially and temporally - with the vessel-based ones and only for those areas monitored by the R/V Song of the Whale. Overall, eight planes monitored more than 55,000 km along predetermined transects, from the Gulf of Cadiz to the West to the Israeli coast to the far East, over a surface of almost 2 million km². A total of 1,672 sightings of cetaceans, totalling 22,652 individuals, were recorded. Ten species of cetacean were encountered during the aerial survey: common bottlenose dolphin (*Tursiops truncatus*), common dolphin (*Delphinus delphis*), Risso's dolphin (*Grampus griseus*), striped dolphin (*Stenella coeruleoalba*), long-finned pilot whale (*Globicephala melas*), Cuvier's beaked whale (*Ziphius cavirostris*), sperm whale (*Physeter macrocephalus*), fin whale (*Balaenoptera physalus*), killer whale (*Orcinus orca*) and minke whale (*Balaenoptera acutorostrata*). Over 1,240 different sightings of non-cetacean species (large vertebrates and marine birds) were also registered, with 11,431 animals in total.

Data were analysed using established design- and model-based analytical frameworks and estimates of abundance for those cetacean species, large vertebrates and marine birds for which sufficient data were obtained. These are provided in the Annexes to this document. Significant effort was also dedicated to collect data on floating marine debris, with the results of this effort detailed in recent published paper by (Lambert *et al.*, 2020).

For the aerial component of the ASI, point estimates from both analytical methods are comparable, as expected, with differences arising mainly in the confidence intervals. 'Best' estimates are considered to be those with the lower confidence intervals. The estimates presented in this report are not corrected for availability or perception bias and are therefore underestimates of true abundance. Effort is ongoing to correct these estimates for some species, and therefore to provide absolute values, and will be considered in future scientific publications. Whilst correcting for potential biases is indeed important in terms of estimates of absolute abundance, is not relevant for trend analyses, where estimates can be treated as indices of abundance, provided that the levels of bias remain constant among surveys over time, by using the same protocols, trained observers and similar planes.

The vessel-based surveys of the ASI were conducted from five vessels between May 2018 and November 2019 and involved over 100 scientists. The survey blocks were largely the same as those designed for the ASI aerial component, with some changes made due to permitting or security constraints. The vessel surveys incorporated more than 17,000 km of track-line over 43 degrees of longitude, covering an area of more than 1.3 million km². During these surveys, 385 sightings of cetaceans, totalling 2,939 animals, were recorded. Confirmed sightings were made of nine cetacean species: common bottlenose dolphin, common dolphin, Risso's dolphin, rough-toothed dolphin (*Steno bredanensis*), striped dolphin, long-finned pilot whale, Cuvier's beaked whale, sperm whale and fin whale, with a possible sighting of a tenth species, false killer whale (*Pseudorca crassidens*), made in the waters of Egypt.

The Song of the Whale team conducted acoustic surveys, in addition to standard visual effort, from the contiguous region in the Atlantic to the Tyrrhenian Sea (blocks 1 to 15, figure 39); additional surveys were conducted in Libyan waters (blocks 25 and 26) and the Hellenic Trench (block 22). The four other vessel surveys took place in Egypt (blocks 27 and 28), Lebanon (block 31) and Syria (block 32).

Aerial surveys followed well established procedures (e.g., Hammond *et al.*, 2013) with pre-planned track-lines flown at constant speed and altitude using high-wing aircrafts equipped with bubble-windows to allow for observation on the track-line. During on-effort flights environmental, weather and sea conditions alongside with sighting related information were recorded on a specialist platform. Sightings were recorded for all the observed cetacean species. In addition, following previous large scale surveys approaches[1] ((Rogan *et al*. 2018, Laran *et al*., 2017 a & b, Pettex *et al.*, 2017) a multi taxa protocol was conducted and several other marine mega vertebrates including fish, reptile and bird species as well as for various human activities such

[1] SAMM, REMMOA, OBSERVE

as fisheries, commercial and recreational marine traffic and the by-products of these activities, such as the presence of floating marine litter.

Vessel surveys were either joint acoustic-visual (considered high priority for deep-diving toothed whales and for those areas where aerial surveys were not permitted) or visual-only (for vessels surveying national coastal waters of Lebanon and Syria, for example, and in areas where hydrophones were not permitted). All surveys were conducted from vessels capable of spending extended periods offshore, with an elevated observation platform of at least 5 m above sea level and allowed two trained observers to scan the sea surface from abeam port to abeam starboard to the boat.

As for vessel-based surveys, research platforms were sailing along predetermined track-lines during on-effort navigation, with the possibility the leave the track to identify species with certainty and to obtain images for photo-identification purposes when appropriate, before returning to the survey track at the point it was left. In addition, R/V Song of the Whale towed hydrophone arrays capable of detecting all cetacean species, including the more elusive sperm and beaked whales. Acoustic effort was conducted continually throughout the survey period, unless weather conditions or water depths made it impractical. Specialist software was used to log environmental information (including sea state, wave and swell height, cloud cover and glare), document the survey effort status at all times, as well as to log sightings of marine life, marine debris, fishing vessels and fishing gear. A standardised database and set of data entry forms were provided to each vessel participating in the ASI.

Main findings arising from both the vessel and aerial component of the ACCOBAMS Survey Initiative are presented in the following paragraphs and will be further discussed in the relevant sections of the report.

Both aerial and vessel-based surveys resulted in the striped dolphin being the most sighted and abundant species in the Mediterranean, with a clear preference for the Western Basin. Estimates were of over 400,000 and approximately 534,000 individuals for the aerial and vessel-based surveys, respectively.

Common bottlenose dolphins showed a discontinued distribution from the Strait of Gibraltar to the area north of the Balearic Islands towards the Gulf of Lion, Corsica and northern Tyrrhenian Sea. They seem particularly abundant in the northern Adriatic Sea, in the Strait of Sicily and in the Aegean Sea. Evidence suggests some degree of preference for coastal waters, but sightings were also recorded in deeper offshore waters. The overall abundance was estimated at about 76,000 animals from the aerial survey and 52,000 from the vessel-based one.

Common dolphins have been mostly sighted in the Western portion of the Basin and in the Strait of Sicily, with a marked preference for waters between latitudes 33° and 38° North. Sightings identified as common dolphins deriving from the aerial survey were only 32, resulting in 66,000 estimated individuals, without considering the part of striped/common dolphin undistinguished, while analysis of vessel-based data resulted in about 134,000 dolphins.

Large cetaceans such as the sperm and the fin whale were also encountered in numbers sufficient to derive their abundance and density. During aerial surveys, fin whales were regularly sighted in the Ligurian Sea, Gulf of Lions and Gulf of Cadiz, Provençal Basin and the Western part of the Pelagos Sanctuary. Their distribution highlights strong preference for pelagic waters. Estimated abundance of fin whales resulted less than 2,000 individuals from the aerial survey and in approximately 13,000 from the vessel-based one.

Sperm whales were detected acoustically throughout the western Mediterranean basin and the Atlantic contiguous region to the Strait of Gibraltar. A total estimate of approximately 4,600 individual sperm whales was derived for the blocks surveyed during the vessel-based survey. Results support previous findings on the distribution of the species in the Mediterranean Sea, with detections sparse in the eastern basin compared to the western basin. Sperm whales were also acoustically detected off Libya, suggesting these waters may be used intermittently by this species.

Sightings and acoustic detections of beaked whales closely matched those regions previously known or predicted to support the highest densities in the Mediterranean Sea, but also indicated previously unsuspected areas e.g., to the west of Sardinia and Sicily. A Cuvier's beaked whale was sighted off the Atlantic coast of Morocco, apparently the first documented sighting in the area. Cuvier's beaked whales were also spotted in Egyptian and in Libyan waters.

Rough-toothed dolphins were sighted in Greek and Egyptian waters – there is increasing evidence that this species is a regular inhabitant of the eastern basin, but just a visitor to the western basin.

Vessel-based acoustic monitoring also showed that ship noise was chronic throughout the survey and evident on every transect surveyed. Seismic airguns and sonar signals were less prevalent but were detected throughout the study area.

Aerial and vessel-based estimates are comparable for most of the observed species, although estimated values show great variation for some species, such as the fin whale and the common dolphin. It is important to underline that while standard visual and acoustic line transect surveys can complement one another to maximise the number of detections per species and should be used together during monitoring programmes, depending on the target specie, they can lead to different estimates. These differences can be explained by the dive and calling behaviour of these species and their diving and surfacing patterns. Furthermore, while the estimates obtained with vessel-based data are corrected for eventual biases, aerial survey ones do not take into account potential biases and therefore are underestimates of the real numbers and, as a consequence, smaller than vessel-based survey estimates. Potential correction factors are provided for aerial surveys and presented in the discussion session.

The cetacean fauna inhabiting the Mediterranean Sea can be easily distinguished at the species level. Nonetheless, during aerial surveys the flight altitude and speed, as well as the sea and weather conditions, amongst other factors, can hamper discriminating species when small delphinids are observed. In the Mediterranean, the co-occurrence of striped and common dolphins, often in mixed-species groups, is a clear example of imperfect species detection. Numerous studies have demonstrated that detection varies among species, over time, and among habitats, and there may be serious consequences when this variability is ignored. For example, failure to correct for imperfect detection may result in bias in estimated relationships with ecological covariates, estimates of species distribution or abundance that are inaccurate or mask trends and improper selection of indicator species (Kellner and Swihart, 2014). These errors can misinform management and policy. In this context, during the ASI survey, when it was not possible to discriminate between these two species, sightings were attributed to a "small dolphin" or "common/striped dolphin" category. Such an approach could be used during the analysis to account for imperfect species detection. By using the proportion between the known occurrence and presence of both species in a given area or region. The fact that in some parts of the Mediterranean (e.g., Gulf of Corinth) mixed-species groups of striped and common dolphins are regularly encountered does not help either.

The 2018-2019 effort has provided an overall picture of the distribution and abundance of cetaceans throughout the ACCOBAMS area, providing robust estimates to be considered as a baseline for further regional systematic monitoring programmes, coordinated and comparable amongst all areas. These data will improve the current knowledge on cetacean status, facilitate the development of targeted conservation and mitigation measures and allow for the follow-up to international obligations (EU, UNEP-MAP). Moreover, they will be used to support both place- and threat-based conservation efforts in the Agreement area, with the identification of Important Marine Mammal Areas (IMMAs) and Cetacean Critical Habitats (CCHs), respectively.

I. OVERALL INTRODUCTION

In the context of the general decline of biodiversity, the need for monitoring programmes at large spatial and temporal scales is widely recognized (Balmford *et al.*, 2005; Green *et al.*, 2005; Pereira and Cooper, 2006), where the aim is assessing changes in species distributions and abundances to predict long-term biological responses to anthropogenic pressures and global changes.

While measuring distribution and abundance of species is crucial to conservation and management (Grand *et al.*, 2007), it is inherently complex to gather information on these population parameters, in particular when dealing with highly mobile, cryptic and threatened species, whose distributional ranges often span across large spaces and where human activities strongly alters natural process, habitats and the species therein (Hughes *et al.*, 2011; Thomas *et al.*, 2015; Guerra *et al.*, 2019; Nykänen *et al.*, 2020).

This is, in fact, true in the Mediterranean and Black Seas, where overall human impacts are high (Micheli *et al.*, 2013a; Halpern *et al.*, 2015, 2019; Stock *et al.*, 2018) and where cetacean populations are threatened (Notarbartolo di Sciara, 2016).

In this context, the ACCOBAMS Survey Initiative (ASI) project aimed at establishing an integrated, collaborative and coordinated monitoring system for the status of cetaceans and other species of conservation concern at the whole ACCOBAMS area level, to provide strong capacity building and training and to ultimately strengthen the conservation effort and governance across the Region.

After being launched officially in 2016, field work was carried out in summers 2018 and 2019, involving several scientist, researchers and experts from the ACCOBAMS region. Following well-established large-scale monitoring initiatives, such as the Small Cetaceans in European Atlantic waters and the North Sea (SCANS), visual line transect distance sampling aerial surveys were complemented by ship-based visual and acoustic distance sampling surveys, to maximise survey effort, area coverage and the likelihood to monitor all the relevant habitats and species. Data were collected for all the cetacean species regularly occurring in the Mediterranean, alongside marine turtles and seabirds and other species of conservation and ecological relevance for which the approach was deemed suitable, as well as for commercially important species. Furthermore, considering that conservation management mediates the interactions between nature, human development and environmental impacts (Johnson *et al.*, 2017; Pecl *et al.*, 2017), a crucial part of the ASI was also the gathering of information on the presence, distribution and levels of human activities and their by-products with the potential to affect ecosystems and species.

This report presents results from both the aerial and the vessel components of the ACCOBAMS Survey Initiative. The report initially presents the details of the aerial surveys, while vessel surveys information is presented in the second section. Detailed graphs and Tables are presented as supplementary information and are annexed to this report.

The ASI represents a very important collaborative effort, coordinated by the ACCOBAMS Secretariat, and undertaken by an extensive international multidisciplinary team with a range of skills and expertise. Large datasets have resulted following cumulative months of survey effort spread across the ACCOBAMS Area in 2018 and 2019. The use of two complementary approaches provides a comprehensive baseline of data on the presence, distribution and abundance for the wide range of cetaceans known to inhabit the Mediterranean Sea, from the larger species including fin whales and the deep-diving sperm whales, to aggregations of small and medium sized cetaceans. This initiative is not the first example of such large-scale synoptic surveys, but the inherent and intimate complexity of the Mediterranean Sea make the ASI a unique case worldwide. The ASI is also an extraordinary achievement greatly improving our knowledge on the cetacean's fauna and in general on the biodiversity of the Mediterranean and contributing towards their conservation.

II. AERIAL-BASED SURVEYS CONDUCTED IN 2018

II.1. METHODS

II.1.1 Survey design

A total of 32 main blocks were originally created, and subsequently divided into smaller sub-blocks. The design of the blocks was based on the best compromise between oceanographic and physiographic characteristics of the entire study area and political/jurisdictional constraints, the former known to markedly affect cetaceans' distributions. The design of the blocks and resulting transects was constantly updated to take into account the continuous evolution of logistic issues such as fuel availability, planes endurance, location of airports and issuing of flight permits.

Transects were designed through the dedicated software Distance 7.3 (Thomas *et al.*, 2010), to obtain an equal coverage probability within each stratum. A systematic zig-zag design (Buckland, 2001; Strindberg and Buckland, 2004) was chosen to optimise effort (Figure 1). Transects were planned to be flown only once. And a ratio Effort/area of about 3% was used to design the survey.

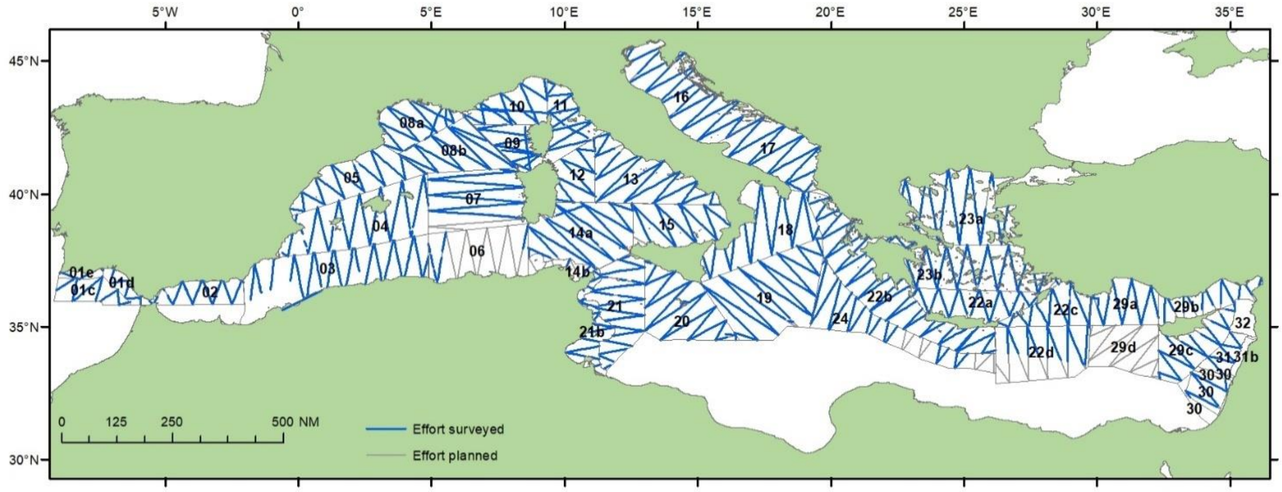


Figure 1. The different blocks and sub-blocks with planned transect (in grey) and effort achieved (in blue).

II.1.2 Data collection

Teams were developed according to previous experience in leading and participating in aerial surveys. All the scientists involved in the survey participated into both theoretical and practical training sessions, during dedicated training to familiarize and prepare for field work activities, protocols, and data collection. Training flights simulating real field conditions were also undertaken to further delve into collected data and fine tune the data collection protocols, which were extensively discussed and analysed. Specific sessions were dedicated to the data logging software SAMMOA[2] and species identification, with effort towards a multi-species approach.

Eight different planes of three different model and specifications were used for the survey: 4 Partenavia (P68), 2 Britten Norman Islander (BN-2) and 2 Cessna Skymaster O-2 push-pull, all equipped with bubble-windows and suitable for aerial surveys at sea.

[2] SAMMOA 1.1.2. Système d'Acquisition des données sur la Mégafaune Marine par Observations Aériennes, Software developed by UMS 3462 Pelagis LRUniv-CNRS and Code Lutin (2012-2019).

Each aircraft accommodated at least three scientists, in addition to the pilot. Target altitude was 183m (600 feet) in accordance with other similar surveys where smaller cetaceans were a key target (Hammond *et al.*, 2013) or dedicated to megafauna (Laran *et al*., 2017a, 2017b; Pettex *et al*., 2017; Rogan *et al.*, 2018), and speed kept at 100 knots. The dedicated software SAMMOA was used by all teams for data collection. SAMMOA is connected to a GPS and has a simultaneously audio recording system to accommodate each observer. Key features of the software include: (a) incorporated flight plan before take-off, with planned track-lines (b) data collection on observer's position, environmental parameters and sightings onboard; (c) data validation with the same interface thanks to the voice recordings; and (d) direct export of the data in GIS format. The tracks of the planes during dedicated flights covered by the different teams are available in Annex I.

Target species of the survey were primarily marine mammals and large fish such as elasmobranchs for which data were collected in 'line transect mode' by recording the declination angle when the animal or group of animals were abeam to the plane (Buckland, 2001). For seabirds and sea turtle a 'strip transect' approach (Buckland, 2001) was instead implemented, with the presence of animals recorded within 200 m of distance on each side of the plane (Figure 2).

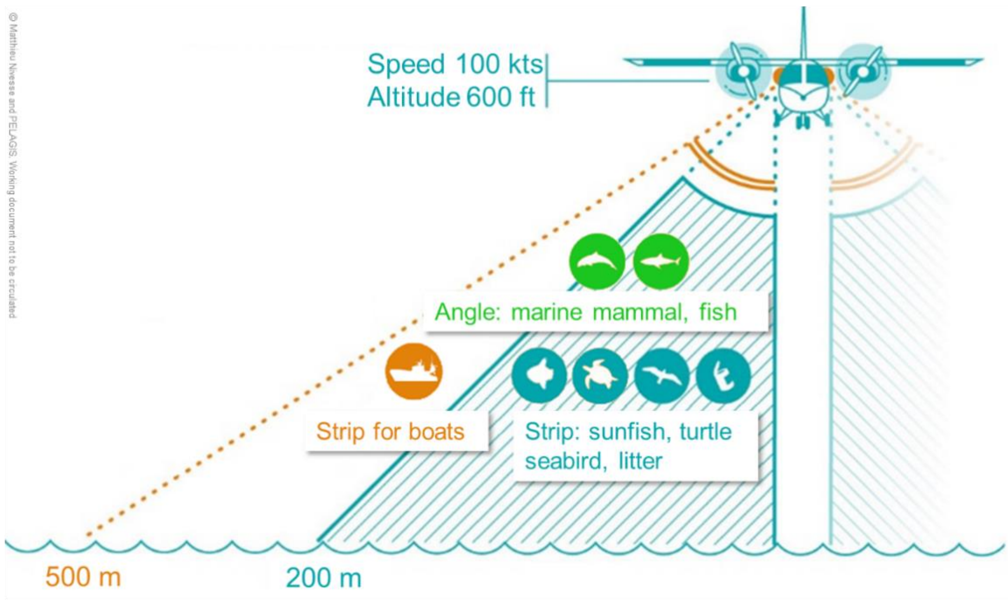


Figure 2. Schematic for data collection of sightings during aerial survey (from M. Nivesse OFB/Pelagis).

Beaufort sea state, glare severity and angle, turbidity, cloud coverage and an overall subjective assessment of the detection conditions (good, moderate or poor as for small dolphin) were recorded at the beginning of each transect and whenever they changed. Good condition is when the observer believes that the likelihood of seeing a small dolphin within the searching area is good (normally a sea state ≤ 2 and a turbidity < 2).

Data collected during cetacean sightings included species (identified to the lowest possible taxonomic level), school size and declination angle (measured with a hand-held clinometer). For some sightings with species and/or school size uncertainty initially, primary search effort was stopped, and a circle-back manoeuvre was implemented to obtain a better identification. Flights were conditional on a good daily weather forecast.

Data were validated by each team after each flight and after double-checking for missing relevant information. At the end of the survey, all the flights from each team were collated and further cleared of previously unnoticed typos and minor errors prior to the analysis.

II.1.3 Data Analysis

Prior to density and abundance estimation analysis survey datasets were queried for explorative descriptive statistics and encounter rates (sightings per unit of effort) were calculated using a grid cell of 50x50 km, using a dedicated plugin, PelaSIG[3] for the software QGIS 2.18 and developed by Pelagis.

Areas and subareas

Although the Mediterranean was divided into relatively small blocks for design purposes (Figure 3), the analysis blocks were merged into larger sectors (referred to as “Subareas” in Figure 4 and “Areas” in Figure 5) to reflect distributional ranges of observed species based on best current knowledge, and to prevent having sectors with little effort and/or too few observations to produce robust estimates.

Although the results of design-based analysis have been performed for each original block, and these are available upon request, this report presents the results as obtained for the above-mentioned areas. Where and if necessary, data could be reorganised to reflect a different grouping of the original blocks, for example to align with the MFSD and EcAp marine Subregions[4].

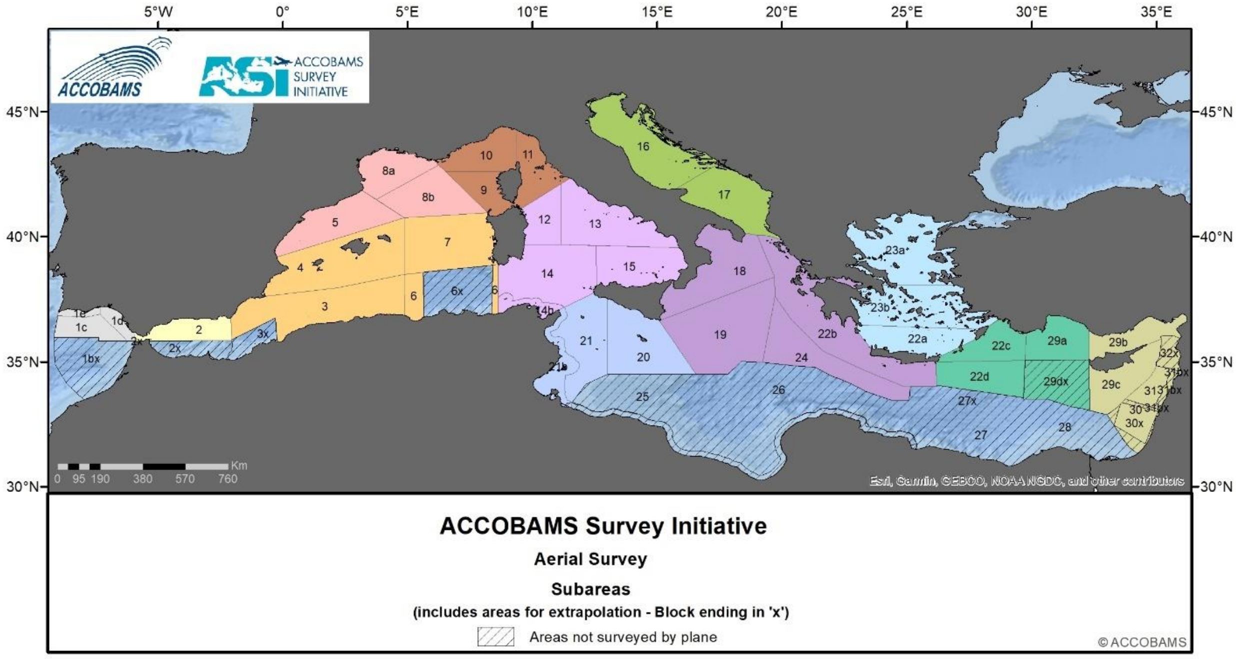


Figure 3. Blocks for the design of the survey.

[3] PelaSIG 2.0. QGIS plugin developped by UMS 3462 Pelagis LRUniv-CNRS (2020)

[4] https://ec.europa.eu/environment/marine/images/MSFD_regions.jpg

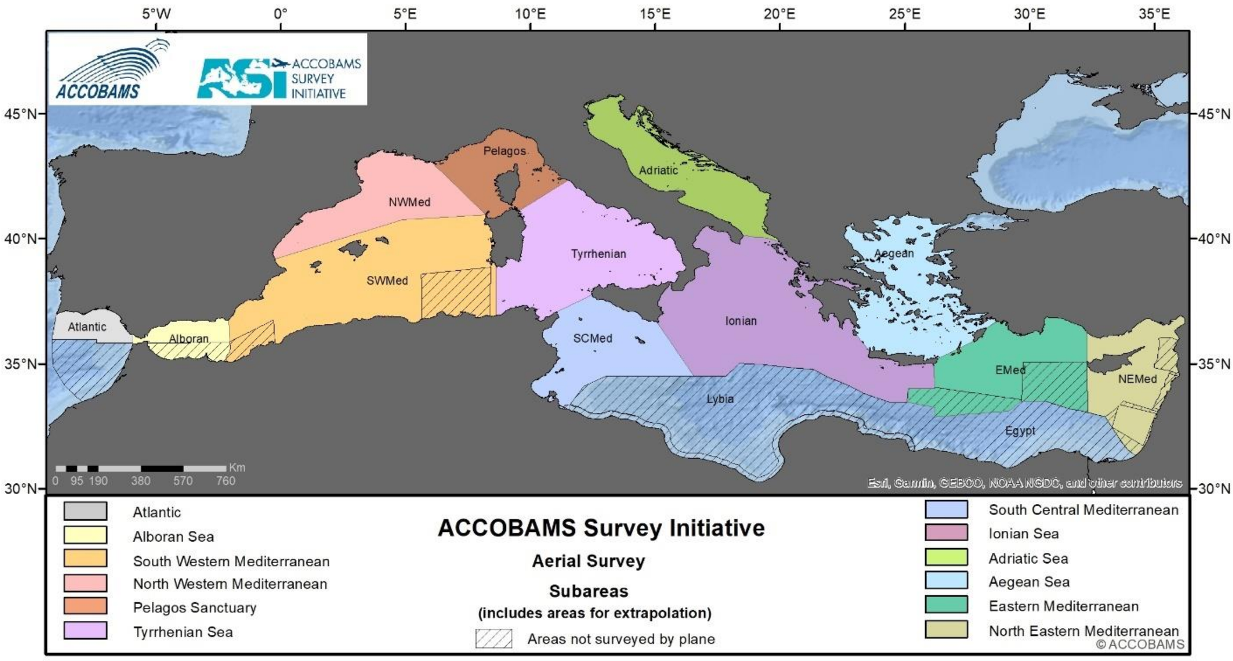


Figure 4. Designation of Subareas for analysis.

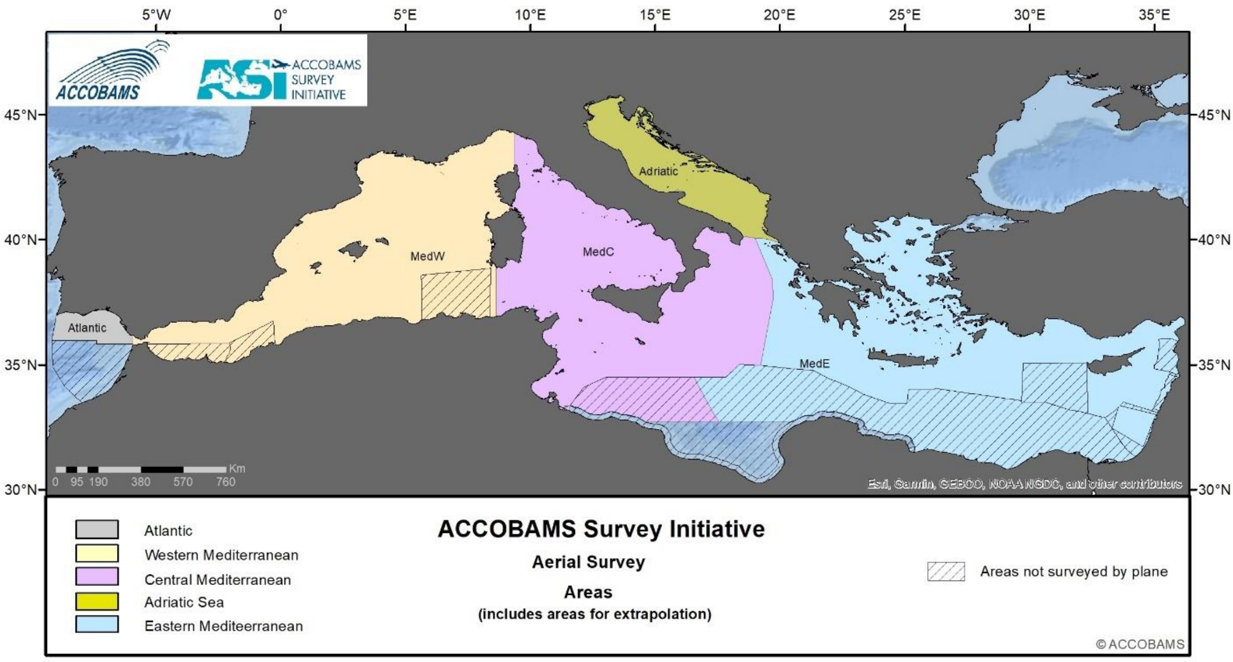


Figure 5. Designation of subregions for analysis.

II.1.4 Design-based analysis

II.1.4.1 Line transect Distance sampling

Analysis of the data followed standard multiple covariate distance sampling approach (MCDS; (Buckland, 2001), where additional explanatory variables are considered along with perpendicular distance to the sightings in the estimation of the detection function (Buckland *et al.*, 2015). Density of schools was estimated from the number of schools sighted, the length of transect searched and the estimated effective strip half-width, *esw* (width of the strip multiplied by the average probability of detection within that strip). Density was calculated as:

$$\hat{D} = \frac{n\bar{s}}{2\mathrm{esw}L}$$

where $\hat{D}$ is density (the hat indicates an estimated quantity), *n* is the number of separate sightings of schools, $\bar{s}$ is mean school size (see below), *L* is the total length of transect searched. The quantity 2 *esw L* is thus the area of the strip that has been searched. The *esw* is estimated from the perpendicular distance data for all the detected animals. It is effectively the width at which the number of animals detected outside the strip equals the number of animals missed inside the strip, assuming that everything is seen at a perpendicular distance of zero. The *esw* was calculated by fitting a detection function to the perpendicular distances to the sightings (see below and Buckland *et al.*, 2001 for further details).
Abundance was estimated as:

$$\hat{N} = A\hat{D}$$

where A is the size of the survey area.

All analysis was undertaken in the software Distance 7.3 (Thomas *et al.*, 2010), which estimates all quantities and their uncertainties.

II.1.4.2 Covariates for the detection function

As noted above, detection functions were fitted to the perpendicular distance data to estimate the esw. For those species with a limited number of sightings (e.g., less than 35) a two steps procedure was followed: (1) a detection function was fitted to a group of species with similar detectability and (2) abundance was finally estimated for a given species using the pooled detection function as calculated above. To do this, the Mark-Recapture Distance Sampling engine (MRDS) available in Distance 7.3 was used with the configuration of "single observer".

The covariates used in the fitting of the detection function(s) were defined during the survey design phase and are presented in Table 1.

The species for which a specific detection function was obtained were bottlenose, striped and Risso´s dolphins. For the remaining species, a pooled detection function was calculated for the following groups:

- Small dolphins (including common, striped and unidentified dolphins), to derive estimates for common dolphins.
- Large dolphins (including bottlenose and Risso´s dolphins and long-finned pilot whales), to derive estimates for pilot-whales.
- Baleen whales except the sighting of one single minke whale (fin whales and unidentified *Balaenopteridae*,).
- Whales (previous group of baleen whales without minke plus sperm whales), to derive estimates for sperm whales.
- Beaked whales.
- Sharks (including blue shark *Prionace glauca* and unidentified sharks).

- Rays (including spinetail devil ray *Mobula mobular* and unidentified rays).
- Large fish (including swordfish *Xiphias gladius* and tuna species).
- Small fish (small and unidentified fish categories).

Table 1. Covariates collected during effort and tested in MRDS models and their ranges or factor levels.

Covariate	Type	Levels
Sighting related		
School size	Numerical	
Observer	Categorical	Observers' names
Effort related		
Beaufort scale	Factor & numerical	0 (calm) 1 (very light) 2 (light breeze) 3 (gentle breeze) 4 (moderate breeze)
Beaufort2	Factor	0-1 2-3 4
Swell	Factor & numerical	0 1 (presence without affecting the detection) 2 (presence + affecting detection)
Water turbidity	Factor & numerical	0 (clear) 1 (moderately clear) 2 (turbid)
Sky glint	Factor	0 (no glint) 1 (glint)
Glare severity	Factor & numerical	0 (null) 1 (slight) 2 (moderate) 3 (strong)
Glare under	Factor	0 (clear) 1 (glare)
Clouds	Numerical	0 to 8 from clear to totally cloudy
Clouds2	Factor	0-2 3-5 6-8
Subjective	Factor	E (Excellent) G (Good) M (Moderate) P (Poor)
Time day (in UTC)	Factor	am (6-12am) noon (12-2pm) pm (2-8pm)
Aircraft	Factor	Names of all aircrafts
Team	Factor	Names of all teams

II.1.4.3 Right truncation

It is common practice to right truncate perpendicular distance data to eliminate sightings at large distances that have no influence on the fit of the detection function close to the transect line (the quantity of interest) but may adversely affect the fit. After visual inspection of the detection function, truncations as summarised in Table 2 and Table 3 were selected for cetaceans and elasmobranchs and fish, respectively. Only for two species right truncation was not necessary and the maximum detected distance was used instead.

II.1.4.4 Model diagnostics and selection

The best functional form (Half Normal or Hazard Rate model) of the detection function and the covariates retained by the best fitting models were selected based on model fitting diagnostics: Akaike Information Criterion (AIC), goodness-of-fit tests based on the Cramer-von Mises statistics, quantile-quantile plots (Q-Q plots), and inspection of plots of fitted functions.

Results of the goodness-of-fit tests are summarised in Table 4 (cetaceans) and Table 5 (elasmobranchs and fish) for all detection functions and are available in the annexes to this document.

Table 2. Parameters and results of the detection functions for cetaceans. Codes: Truncation = right truncation; Max. distance = largest perpendicular distance observed; n = number groups in detection function after truncation; key functions: HN = half-normal, HR =hazard-rate; p=average probability of detection; CV p = coefficient of variation of the probability of detection; esw = effective half-strip width in m.; CvM p = p-value of the Cramer von Mises goodness of fit.

Species/group	**Truncation**	**Max. Distance**	**n**	**Key function**	**Covariates**	**p**	**CV p**	**esw**	**CvM p**
Whales	1303		67	HN	Glare severity (as factor)	0.3677	0.1674	479	0.3383
Baleen whales		1741	52	HN	Glare severity	0.371	0.2108	646	0.7437
Beaked whales		359	20	HR	null	0.7554	0.1638	271	0.871
Tursiops truncatus	800		169	HR	Sky glint	0.3269	0.0824	262	0.9053
Grampus griseus		503	60	HR	Seastate2	0.5056	0.1305	254	0.3092
Stenella coeruleoalba	700		263	HN	Glare severity (as factor)	0.3174	0.0438	222	0.1408
Small dolphins	700		515	HN	Aircraft - Turbidity	0.3417	0.0350	239	0.3520
Large dolphins	800		256	HR	Seastate – Sky glint	0.3355	0.0634	268	0.9921

Table 3. Parameters and results of the detection functions for other megafauna. Codes: Truncation = right truncation; Max. distance = largest perpendicular distance observed; n = number groups in detection function; key functions: HN = half-normal, HR =hazard-rate; p=probability of detection; CV p = coefficient of variation of the probability of detection; esw = effective half-strip width; CvM p = p-value of the Cramer von Misses goodness of fit.

Species/group	**Truncation**	**Max. Distance**	**n**	**Key function**	**Covariates**	**p**	**CV p**	**esw**	**CvM p**
Sharks	420	420	149	HR	Clouds	0.4287	0.0611	180	0.8494
Rays		393	263	HR	Glare under -Turbidity	0.5606	0.0425	220	0.5657
Large fish	540	540	404	HR	Subjective - Turbidity	0.416	0.04	225	0.3103
Small fish	510	510	144	HR	Sky glint-Subjective	0.394	0.07	201	0.5160

II.1.4.5 Strip transect

Strip transect analysis does not require fitting a detection function to perpendicular distance data, and it assumes that all individuals are visible at the surface within a particular distance from the track-line. Although a much simpler method, its use depends on the validity of this assumption and given a sufficient sample size within the chosen strip. The basic analysis was done by using a 0.2km strip as the half strip with, and therefore the search area is Lx2x0.2 (where L is the length of the segment). Density is then estimated by dividing the number of sightings/animals by the surface area of each strip integrated along all the stripes of a block. This density is then extrapolated to the whole study area (by regions and subregions) by multiplying the density by the surface area of the target study area. The CV and 95% CI are derived from the variability of the density in all segments for each target study area (subregions and regions).

II.1.5 Model-based analysis

Density surface models were produced by modelling species abundance as a function of appropriate environmental covariates. A spatial grid at a resolution of 10x10 km was overlayed to the survey area to associate environmental covariates values to on-effort segments within each grid cell to predict abundance spatially. The resolution of the grid cells was chosen as the finest consistent resolution that captures all available environmental covariates. Environmental data were then assigned to the centre of each grid cell.
Environmental variables, obtained from several sources, included: water depth (m), distance to several depth contours (as proxies for coastal, continental shelf, oceanic habitats), distance to canyons and seabed slope. As indices of marine hydrology and/or biological activity/primary productivity, sea surface temperature (°C), mixed layer depth (m) and levels of chlorophyll-a (mg/l) were also included. For a complete list of variables used, see Table 4.

The count of groups in each segment (N_i in i^{th} segment) within each grid cell was used as the response variable. The density of groups was modelled using a Generalized Additive Model (GAM) with a logarithmic link function, and a Tweedie error distribution, very close to a Poisson distribution but allowing for some over-dispersion. The general structure of the model is:

$$\widehat{N_i} = exp[ln(a_i) + \theta_0 + \sum_k f_k(z_{ik})]$$

where the offset a_i is the effective search area for the i^{th} segment (calculated as the length of the segment multiplied by twice the *esw*), Θ is the intercept, f_k are smoothed functions of the explanatory covariates, and z_{ik} is the value of the k^{th} explanatory covariate in the i^{th} segment. The *esw* was obtained for each species/species group from their detection function, according to the covariates included in it. The abundance is then estimated by multiplying the density by the survey area.

Abundance per species in each grid cell were obtained by multiplying the abundance of groups, predicted from the best fitting model, by the mean group size estimated for each substratum or the modelled group sizes if spatial variation was observed. In the case of modelled group sizes, the observed group size of each sighting was taken as response variable, no offset was used, and the distribution family was negative binomial. For fin whales, however, the number of animals was modelled directly (instead of two steps) due to the very small group sizes and the little variability in them. In these cases, the same framework was used as for the model of groups, but using number of individuals instead of number of groups as the response variable.
Variance of abundance was estimated by a parametric bootstrap procedure, also called "posterior simulation" (Miller *et al.*, in prep). The delta method was used to combine the CV from the bootstrap with

the CV from the detection function and from the model. The 95% Confidence Interval (CI) will be obtained using the final CV and assuming the estimates were lognormally distributed. All modelling was carried out using the statistical software R.4.0.3 (R Core Team, 2020) using the *mgcv* 1.8-33 package (Wood, 2017).

Table 4. Environmental covariates tested in the spatial models.

Covariate	Description
Fixed*	
Lat	Latitude
Lon	Longitude
Aspect	Orientation of the sea floor (0-359º)
CI	Contour index (max-min depth/max depth)
Depthmin	Minimum depth within the grid cell
Depthmean	Mean depth within the grid cell
Depthmax	Maximum depth within the grid cell
Dist0	Minimum Distance to coast
Dist100	Minimum Distance to the 100m depth contour
Dist500	Distance to the 500m depth contour
Dist1000	Distance to the 1000m depth contour
Dist2000	Distance to the 2000m depth contour
Distcany	Distance to canyons*
Distesc	Distance to escarpments*
Distcanes	Distance to canyons/escarpments*
Distshelf	Distance to the continental shelf*
Distslope	Distance to the slope*
Slope	Slope of the sea floor (in %)
Dynamic**	
Chl_0608	Mean chlorophyll concentration for June-August 2018
Chl_month	Mean chlorophyll concentration for the month the segment was surveyed
Mlt_0608	Mean mixed layer thickness for June-August 2018
Mlt_month	Mean mixed layer thickness for the month the segment was surveyed
Ssh_0608	Mean sea surface height anomaly for June-August
Ssh_month	Mean sea surface height anomaly for the month the segment was surveyed
Sst_0608	Mean sea surface temperature for June-August
Sst_month	Mean sea surface temperature for the month the segment was surveyed
SD_Sst_0608	Standard deviation of the sea surface temperature for June-August, within the grid cell
SD_Sst_month	Standard deviation of the sea surface temperature for the month the segment was surveyed, within the grid cell

* With data from http://www.bluehabitats.org (Harris et al 2014)

** Data downloaded from Copernicus platform: https://www.copernicus.eu/en/

II.2. RESULTS

The survey was planned over a total area of 1 937 257 Km² with a ratio Effort/area varying between 2.7 and 3.6%. About 91% of the planned design was achieved with in addition some extra effort line (to optimise transit of the plane) totalising 1,472 km. (Figure 6, Table 5)

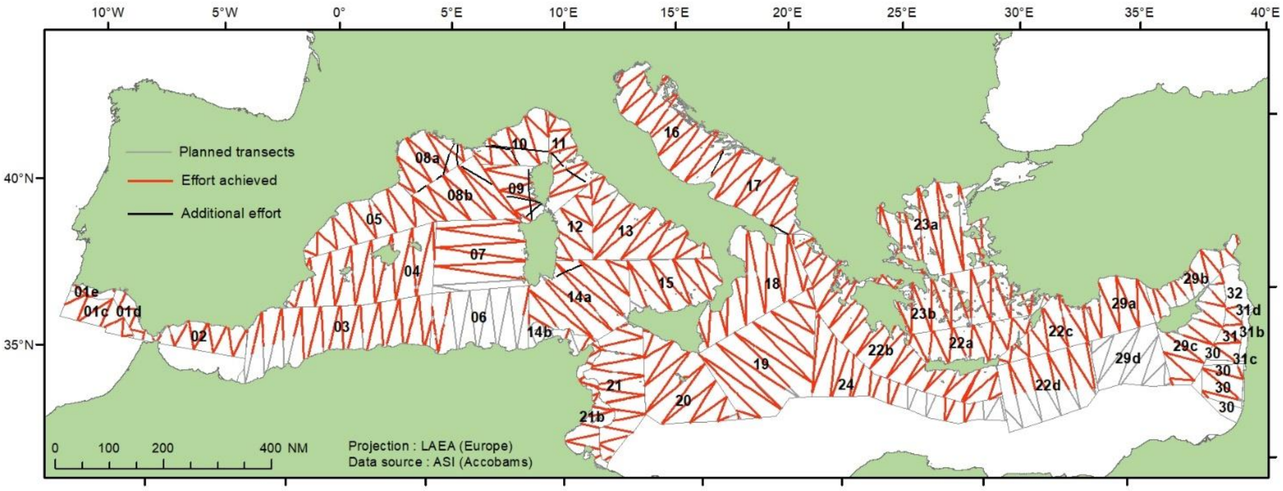


Figure 6. Planned transect, effort achieved and additional effort during aerial survey

Table 5. Details by surveyed box of their respective area (km²), planned transect (km), total of prospection effort achieved (km), percentage (without considering effort on additional line) and additional effort (in km).

Block name	Area (km²)	Transect planned (Km)	Total effort achieved (km)	% achieved (without additional effort)	Additional effort (km)
1c_Gulf_Cadiz_N_half_offshore_noFIR	20 038	587	585	99.7%	0
1d_Gulf_Cadiz_N_half_shelf_East_noFIR	8 174	249	234	93.9%	0
1e_Gulf_Cadiz_N_half_shelf_West	4 167	112	96	85.6%	0
2_Alboran_noFIR	27 061	892	855	95.8%	0
3_AlgeriaWest_complete	105 457	3 342	2 703	80.9%	0
4_Baleares	90 081	2 771	2 677	96.6%	0
5_NE_Spain	52 647	1 570	1 500	95.6%	0
6_AlgeriaEast_complete	64 550	2 009	420	20.9%	0
7_WestSardinia	71 732	2 248	1 839	81.8%	0
8a_GulfLion-inshore	34 628	1 087	1 312	120.7%	239
8b_GulfLion-offshore	46 324	1 647	1 769	107.4%	122
9_PelagosSW	22 423	645	1 028	159.3%	362
10_PelagosNW	34 110	978	1 290	131.9%	337
11_PelagosE	30 947	890	1 030	115.7%	144
12_TyrrhenianCWest	26 748	835	968	116.0%	0
13_TyrrhenianCEast	65 621	2 110	2 035	96.4%	0
14a_TyrrhenianSWest_offshore	74 645	2 474	2 410	97.4%	102
14b_TyrrhenianSWest_inshore	10 167	319	219	68.8%	0
15_TyrrhenianSEast	48 298	1 488	1 401	94.1%	0
16_AdriaticNC	78 718	2 361	2 077	88.0%	96
17_AdriaticS_new	56 413	1 739	1 721	99.0%	69
18_IonianN_new	74 009	2 234	2 147	96.1%	0

19_IonianS	105 174	3 227	3 127	96.9%	0
20_SicilySouth	65 252	2 088	2 044	97.9%	0
21_ Tunisia_East_offshore	56 541	1 673	1 621	96.9%	0
21b_Tunisia_East_inshore	23 411	680	784	115.3%	0
22a_HellenicTrench_North	40 768	1 346	1 326	98.5%	0
22b_HellenicTrench_West_final	103 478	3 295	3 417	103.7%	0
22c_HellenicTrench_East_Greece_final	32 735	1 159	1 107	95.6%	0
22d_SECrete_final	68 066	2 073	1 261	60.9%	0
23a_AegeanN	76 502	2 353	2 231	94.8%	0
23b _AegeanS	67 375	2 208	2 180	98.8%	0
24_IonianSE_final	68 481	2 307	1 755	76.1%	0
29a_Cyprus_West_final	36 364	1 178	1 149	97.5%	0
29b - Cyprus_NEast	30 263	949	757	79.8%	0
29c_Cyprus_SEast	41 276	1 331	1 145	86.0%	0
29d_Cyprus_SWest_final	43 641	1 358		0.0%	0
30_Israel_final	17 146	547	508	92.9%	0
31_Lebanon_offshore	13 827	451	439	97.3%	0
	1 937 257	60 808	55 167	90.7%	1 472

Survey condition varied throughout the surveys, with the best sea state conditions (as defined previously) encountered in the NW Mediterranean and Adriatic, and the poorest conditions in the Aegean and south of Greece (Figure 7 A). Similarly, subjective conditions were best in the northern NW Mediterranean but comparatively poor off Algeria, in the Aegean and various other spots across the basin (Figure 7 B). It is important to highlight that these conditions, despite integrating all other sea, weather and environmental factors, are by definition "subjective" as they are defined as the probability of an observer detecting a common dolphin. Glare severity was maximum in the NW Mediterranean and variable elsewhere (Figure 7 C). Cloud cover was minimal in the central Mediterranean, Tyrrhenian, Adriatic and Aegean (Figure 7 D).

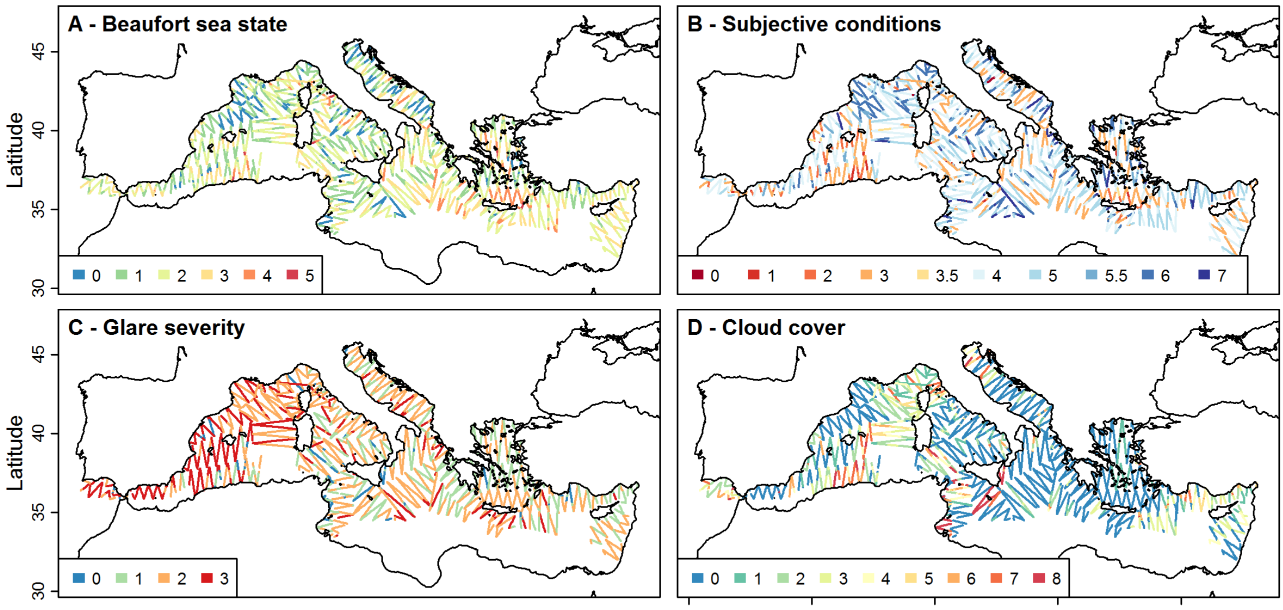


Figure 7. Weather condition encountered along the survey. **Sea state:** Beaufort scale; **Subjective:** 0=Poor on both sides of the plane to 7=excellent on both sides; **Glare severity:** 0= no glare to 3= strong glare and **Cloud cover** (octars system).

II.2.1 Search effort and sightings

The strong advantage of the megafauna-protocol, used for ASI, is the multiple results given for different taxa of marine megafauna, allowing comparisons of encounter rate distribution across broad taxa (Figure 8). Cetaceans were mostly encountered on the western part of the surveyed area, while seabirds showed maximum values in coastal areas, east of Tunisia, as well as in the Adriatic and Aegean seas. Hard-shelled sea turtles were mostly encountered in offshore waters of the western basin, south east of Messina and north of the Adriatic Sea; finally, large fish and elasmobranchs were primarily encountered north of the Balearic Islands to the Gulf of Lions or south of the Adriatic Sea.

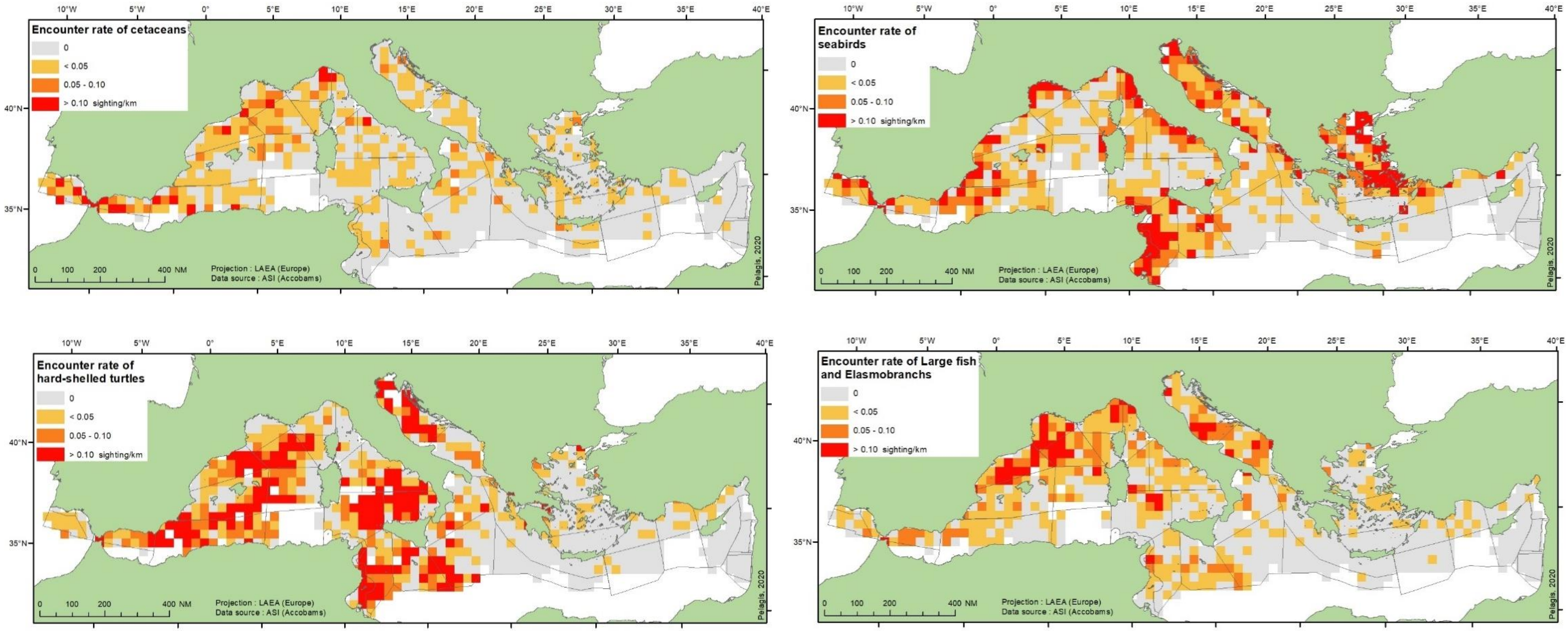


Figure 8. Encounter rate (sightings per km of effort on a grid of 50x50 km) for cetaceans, seabirds, hard-shelled turtles and elasmobranchs.

II.2.1.1 Cetaceans

Maximum values of encounter rate of cetaceans were detected in the North portion of the Western basin, from the Ligurian Sea to the Strait of Gibraltar (Figure 8). Figure 9 presents an overview of the species composition of sightings observed during the aerial surveys, while Table 5 presents the summary of sightings; striped dolphins were the most observed species, followed by bottlenose dolphins and to a lesser extent, Risso's dolphins. In several instances (18%) it was not possible to discriminate between striped and common dolphins.

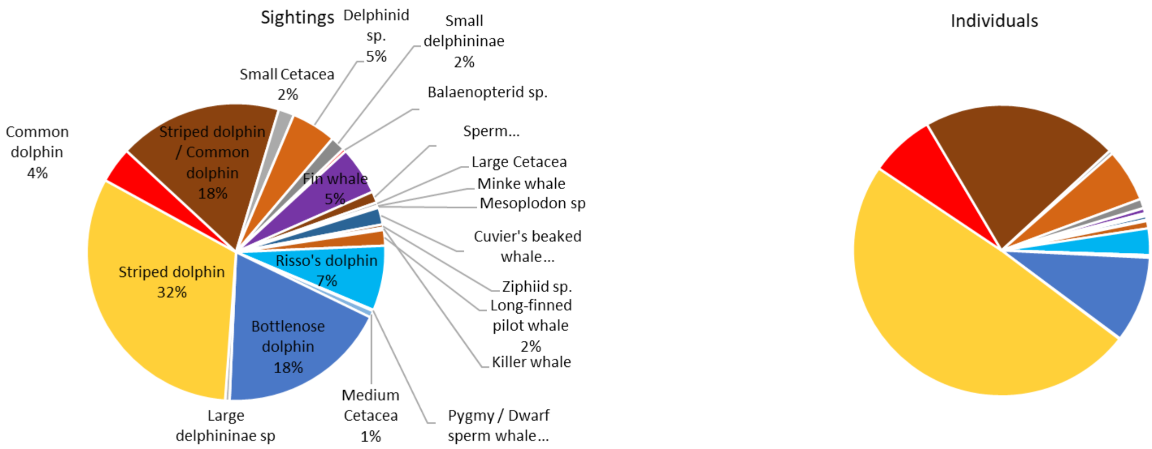


Figure 9. Species composition of sightings of cetaceans collected on effort during the aerial survey, in percentage of sightings (left) and of individuals (right).

Table 6. Sightings of cetaceans encountered while 'on effort' during the aerial survey.

Taxonomic groups		Species or taxa	Sightings	Individuals
Balaenopteridae	Large Balaenopteridae	Balaenoptera sp.	3	6
		Fin whale	43	65
	Small Balaenopteridae	Minke whale	1	1
Cetacea	Cetacean unidentif.	Cetacea	2	3
		Large Cetacean	3	12
		Medium Cetacean	6	32
		Small Cetacean	14	48
Delphinidae	Delphinid	Delphinid sp.	40	692
Delphinidae	Large Delphinidae	Bottlenose dolphin	152	1128
		Large delphinidae sp.	4	10
	Small Delphinidae	Common dolphin	32	842
		Small delphinidae	13	121
		Striped dolphin	262	5819
		Striped dolphin / Common dolphin	146	2532
Globicephalidae	Large globicephalidae	Killer whale	2	13
		Long-finned pilot whale	14	96
	Small globicephalidae	Risso's dolphin	58	350
Kogiidae	Sperm whale	Pygmy / Dwarf sperm whale	1	1
Physeteridae	Sperm whale	Sperm whale	10	24
Ziphiidae	Mesoplodon	Mesoplodon whales sp.	1	3
	Other beaked whale	Cuvier's beaked whale	15	47
		Ziphiidae sp. (Beaked whale)	3	4

Striped dolphins (or unidentified striped/common dolphins) were mostly encountered in the Western Basin (Figure 10), while common dolphins were only identified between 33° and 38°North.

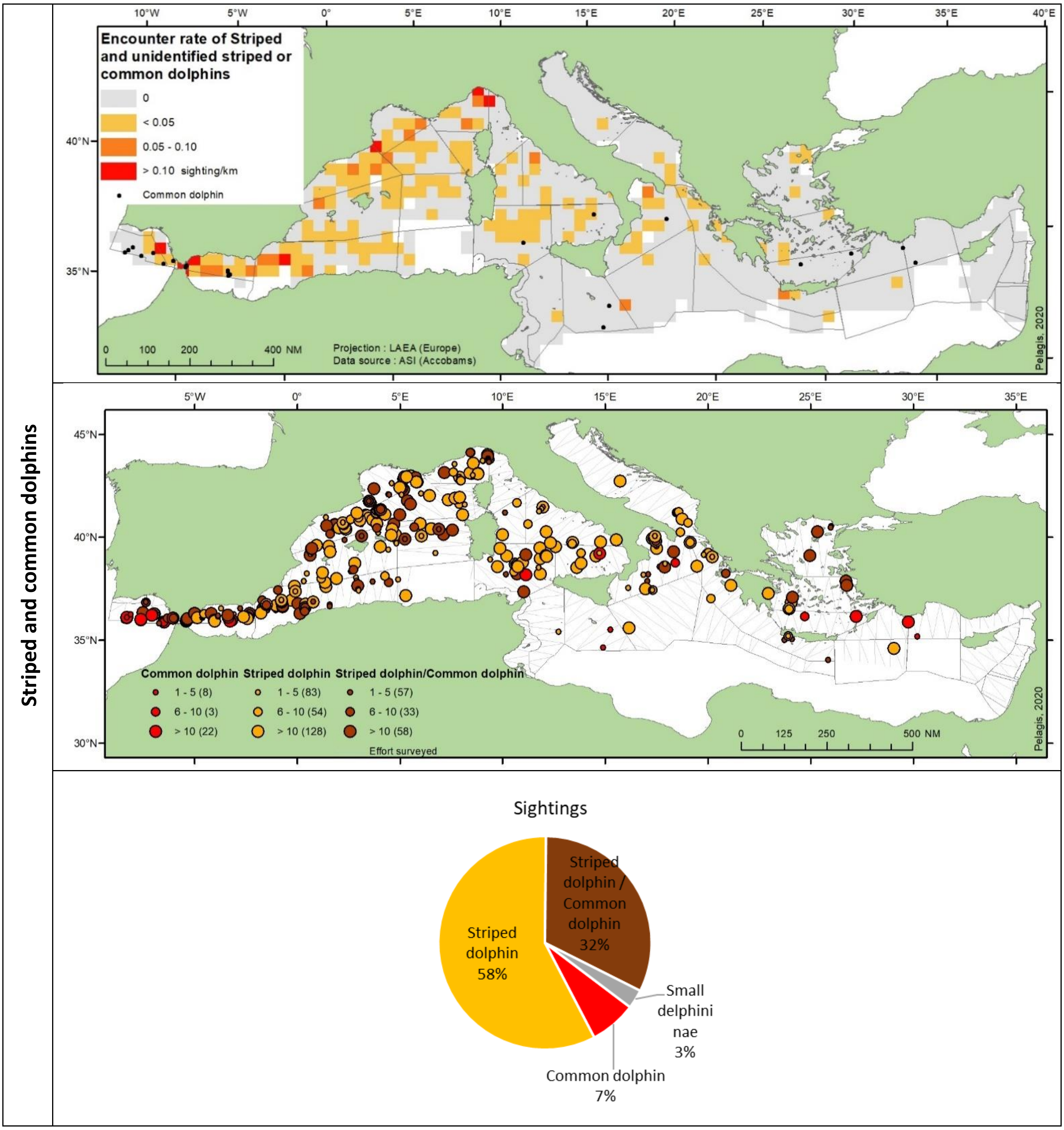


Figure 10. Encounter rate (sighting per km) of striped and unidentified striped or common dolphins on a grid of 50x50 km. Effort surveyed with sightings by species with class of pod size (and number of sightings by class) during aerial survey. And global specific composition by species or group.

Common bottlenose dolphins exhibit a 'patchy' distribution from Gibraltar, North of the Balearic Islands to the Gulf of Lion, Corsica and north of Tyrrhenian Sea, all the Adriatic Sea and more slightly East coast of Tunisia, and Aegean Sea (Figure 11). There is no strong apparent preference for coastal areas, with several groups detected in the pelagic environment.

The encounter rate map of Risso's dolphin denotes a strong 'preference' for the Western part of the Mediterranean Sea in summer, from the Alborán Sea to the south of the Provençal Basin, with high values along the Algerian coast and the Balearic Islands (Figure 12). Again, this distribution shows no strong preference for coastal areas, with several groups detected in the pelagic environment. Long-finned pilot whales were only encountered west of 12° W.

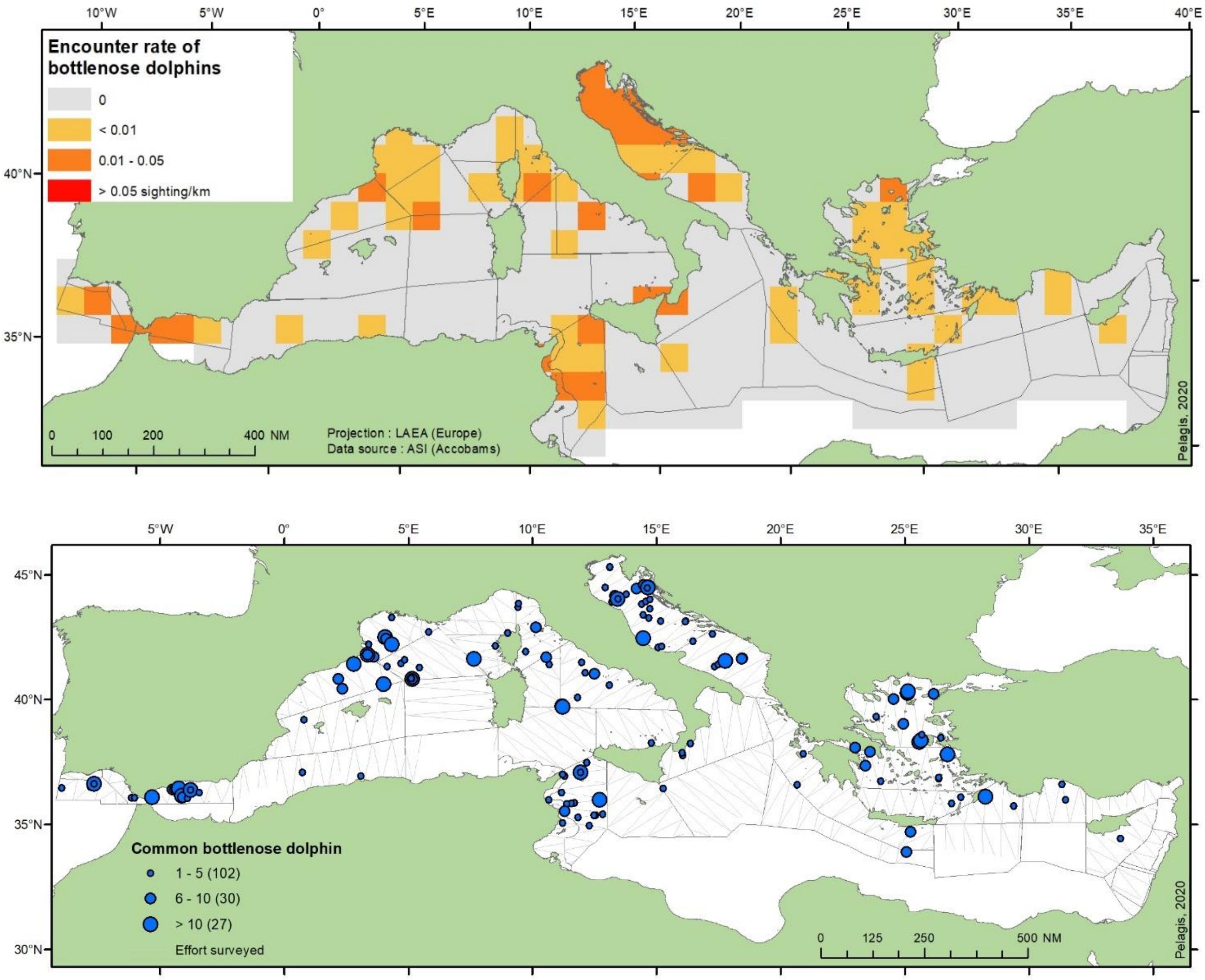


Figure 11. Encounter rate of bottlenose dolphins (sighting per km) on a grid of 100x100 km. And effort surveyed with sightings by species with class of pod size (and number of sightings by class) during aerial survey.

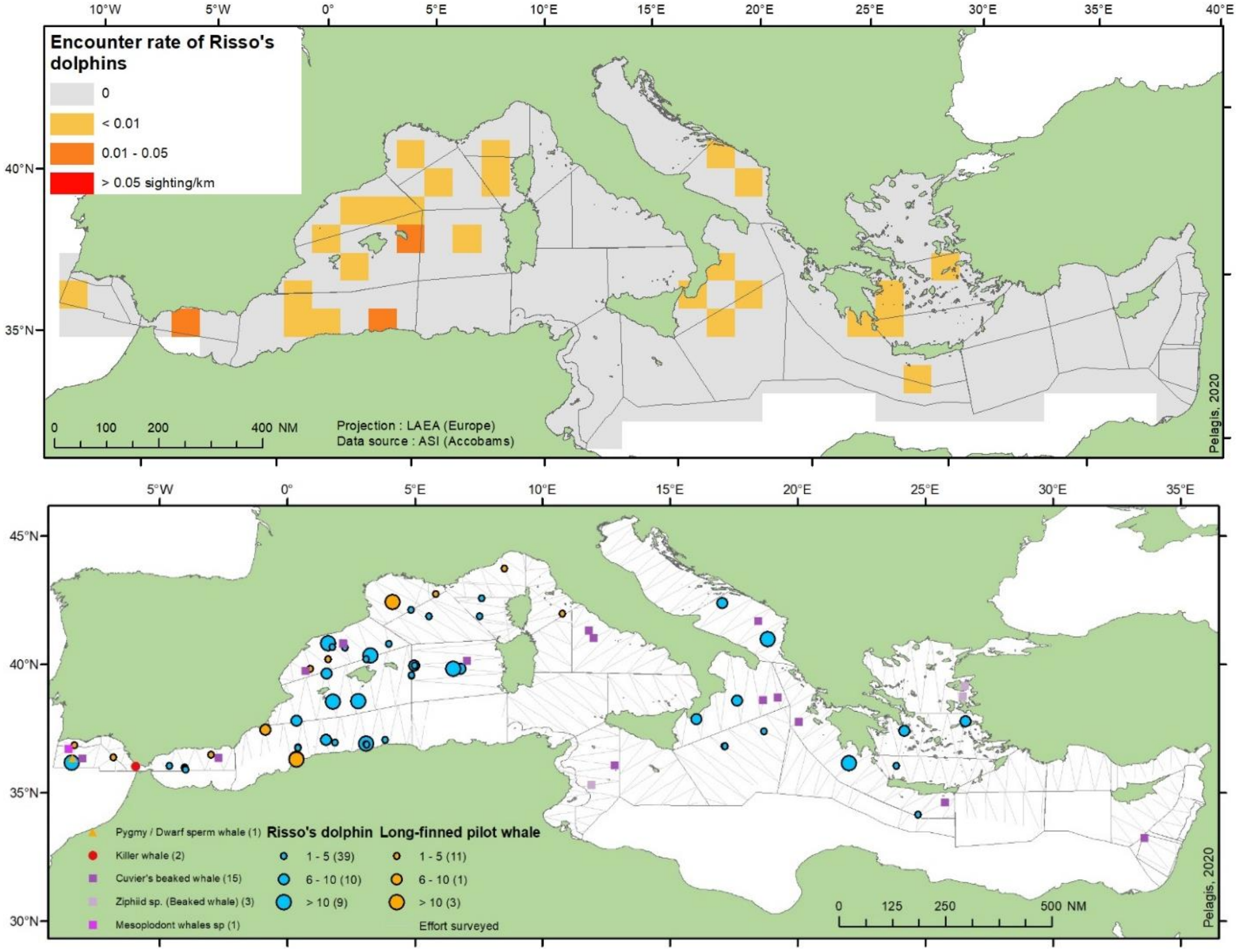
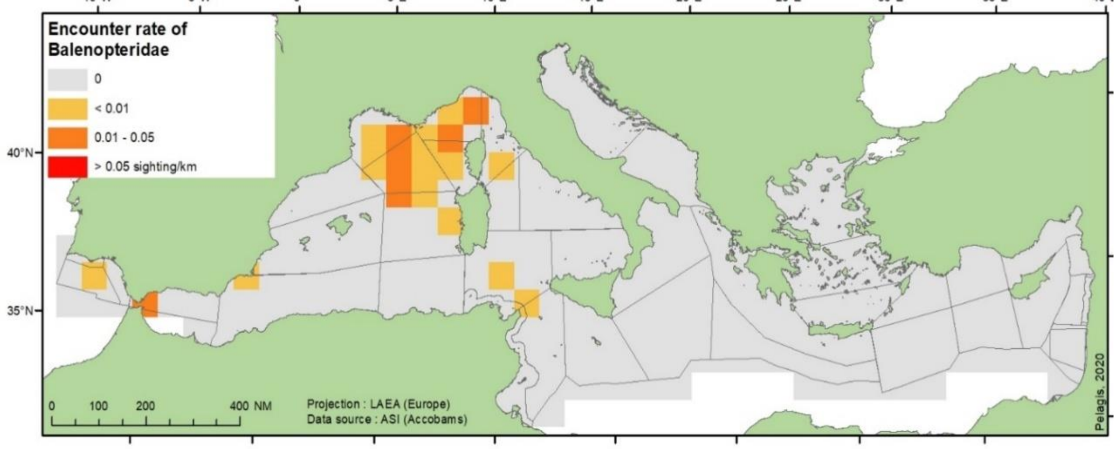


Figure 12. Encounter rate of Risso's dolphins (sighting per km) on a grid of 100x100 km. Effort surveyed with sightings by species with class of pod size (and number of sightings by class or species) during aerial survey.

Fin whales were encountered from Gibraltar to the North of Tunisia, with maximum encounter rates in the Provençal Basin and the Western part of the Ligurian Sea (Figure 13). This distribution implies no strong preference for coastal areas with several groups detected offshore.

Sperm whales were encountered in both basins, but sightings were restricted to between 35° to 40° North (Figure 13). Deep diver species (beaked whales, sperm whales and Kogia spp.) were encountered throughout the study area (Figure 14). Unidentified cetaceans are presented in Figure 15.



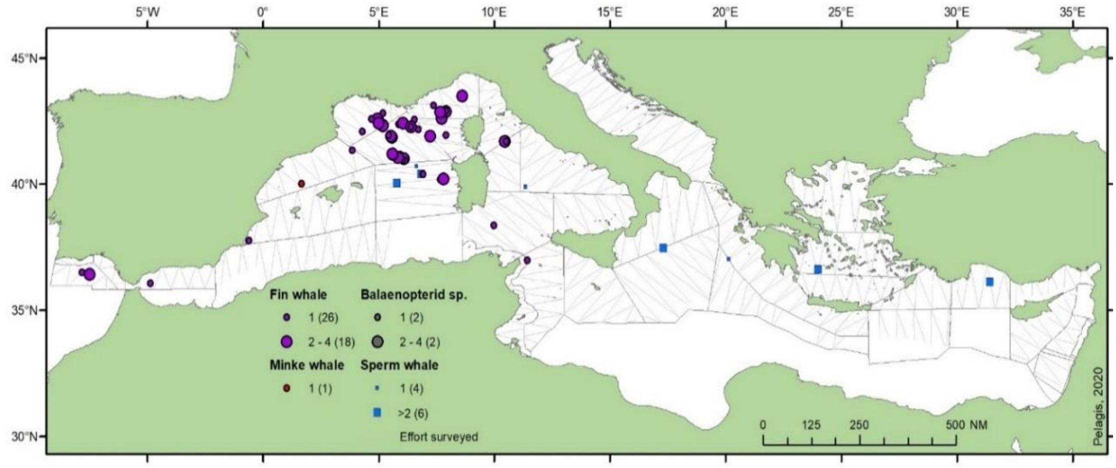


Figure 13. Encounter rate of baleen whales (sighting per km) on a grid of 100x100 km. And effort surveyed with sightings by species with class of pod size (and number of sightings by class) during aerial survey.

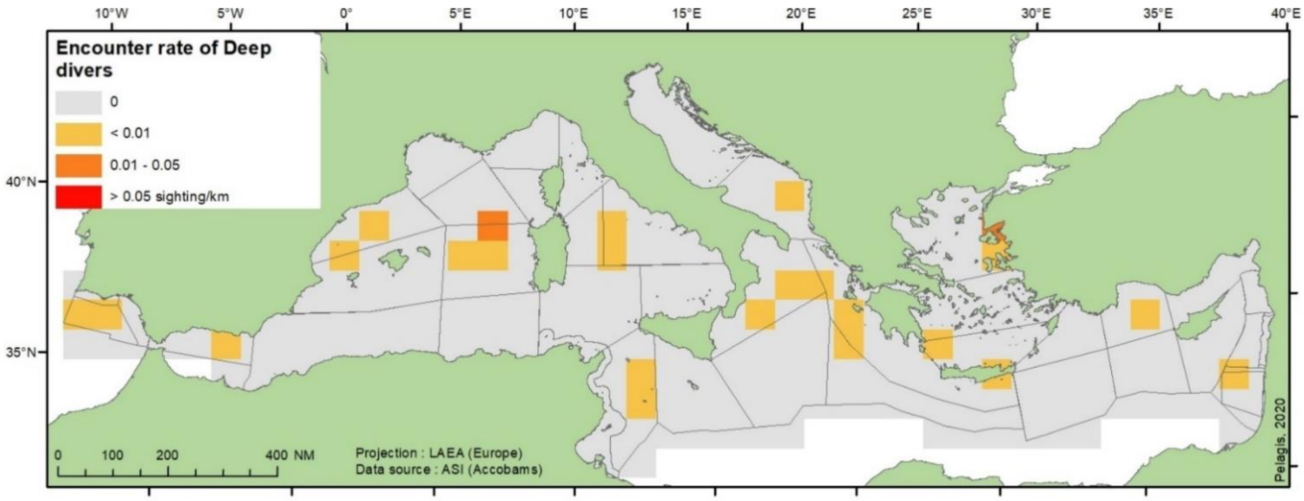


Figure 14. Encounter rate of deep divers (sighting per km): *Kogia spp.*, sperm whales and Ziphiidae on a grid of 100x100 km. And effort surveyed with sightings by species with class of pod size (and number of sightings by class) during aerial survey.

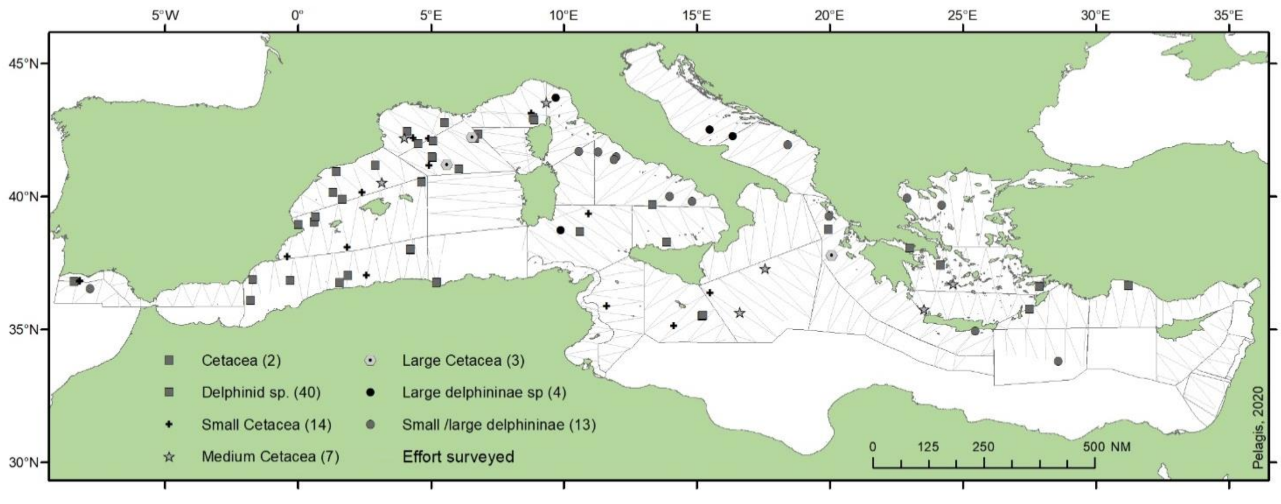


Figure 15. Effort surveyed and sightings of cetaceans unidentified during aerial surveys.

II.2.1.2 Seabirds

Figure 16 presents an overview of the species composition of seabirds' sightings observed during the aerial surveys, while Table 7 presents the summary of sightings. Shearwaters (42%) and gulls (46%) were by far the most observed species, with almost 90% of the sightings. In 5% of the cases it was not possible to assign a taxonomic group to the observation, which was categorized as 'other bird'.

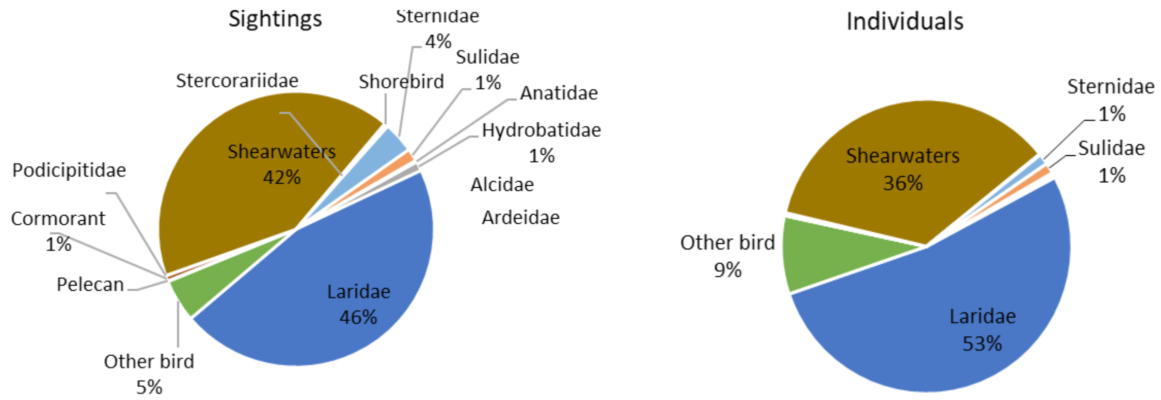


Figure 16. Species composition of sightings of seabirds collected on effort in sightings (left) and in individuals (right).

Table 7. Sightings of marine birds encountered while 'on effort' during the aerial survey monitoring.

Family	**Group_**	**Species or taxa**	**Sightings**	**Individuals**
Laridae	Grey gull	Large "grey" gull sp	542	2206
	Small grey gull	Audouin's gull	1	1
		Common gull	11	12
		Medium gull sp	90	269
	Small gull	Black-headed gull	2	2
		Mediterranean gull	26	265
		Small gull sp	158	660
	Other gull	Gull sp	237	1,221
	Larids	Larids unidentif.	178	1,679
Procellariidae	Large shearwater	Cory's shearwater	666	1,901
		Large shearwater sp.	211	632
	Shearwater	Shearwater sp.	32	540
	Small shearwater	Small shearwater sp.	221	1,200
Stercorariidae	Other skua	Skua	6	6
Sternidae	Grey tern		1	1
	Tern unidentif.	Tern sp.	98	141
Sulidae	Booby	Gannet	40	140
Hydrobatidae	Storm-petrel	European storm-petrel	30	41
Phalacrocoracidae	Cormorant	Cormorant / shag sp	17	34
Pelecanidae	Pelican	Pelican sp.	2	3
Alcidae	Auk unidentif.	Auk sp	3	3
Anatidae	Canard	Duck sp	2	25
Ardeidae	Echassier	Heron sp	1	1
Podicipitidae	Grebe	Grebe sp	1	1
Shorebird	Shorebird unidentif.	Shore bird unidentif.	6	7
Other bird	Apodidae	Swift undeterminded	4	4
	Aves	Land Bird	25	535
	Bird of prey	Bird of prey undetermined	4	4
	bird unidentif.	Unidentified Bird	104	491
			2,520	10,876

Higher values of encounter rate of gulls were obtained in the Adriatic Sea, East of Tunisia, Italian coast of Tyrrhenian Sea, around Sardinia and south Corsica islands, and Aegean Sea (Figure 17).

Higher values of encounter rate of shearwaters were encountered South East of Tunisia, in the Aegean Sea and between Alborán and Balearic Sea (Figure 18). Other species of seabirds encountered during the survey were presented in Figure 19.

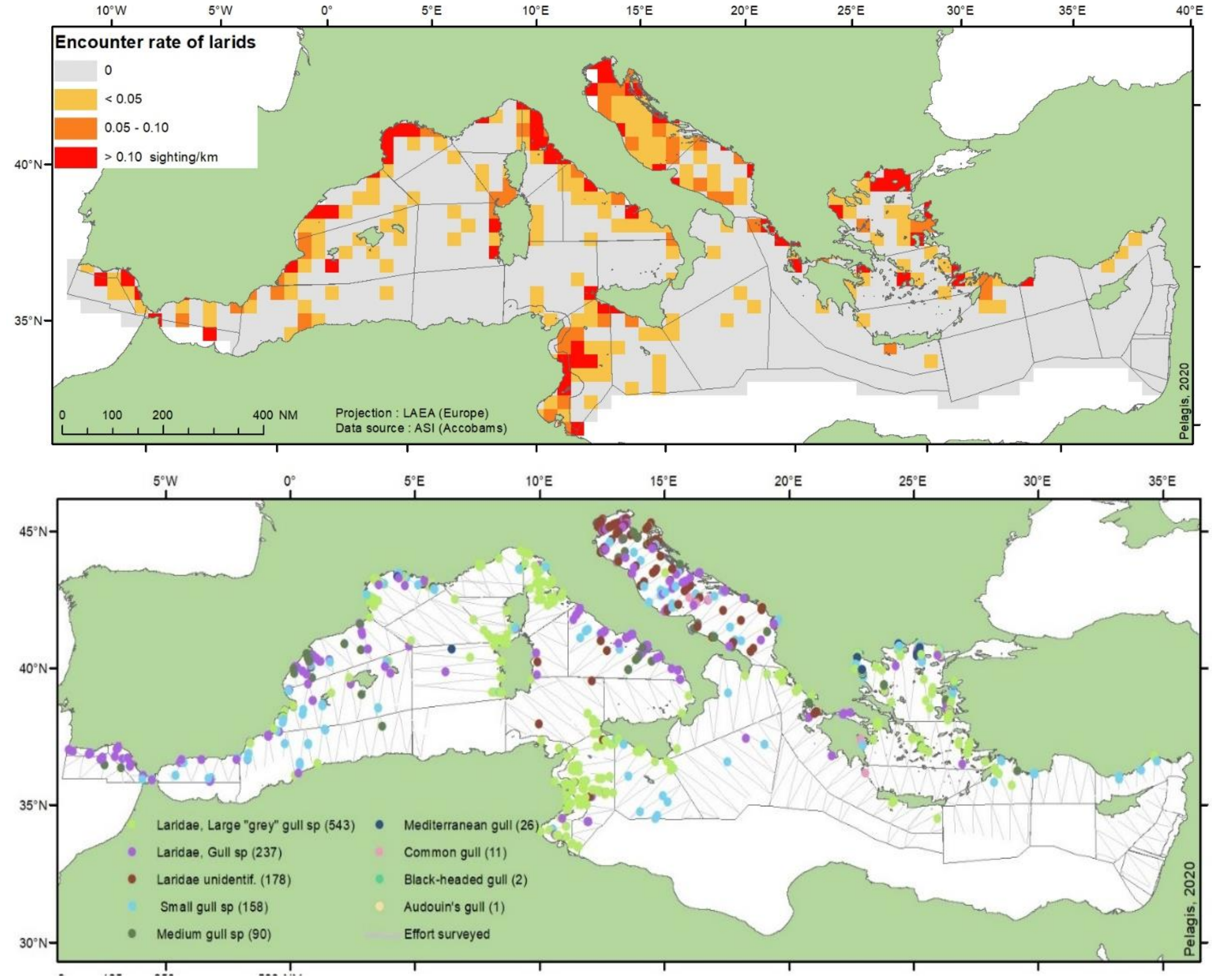


Figure 17. Encounter rate of larids (sighting per km) on a grid of 50x50 km. And effort surveyed with sightings by species with class of pod size (and number of sightings by class) during aerial survey.

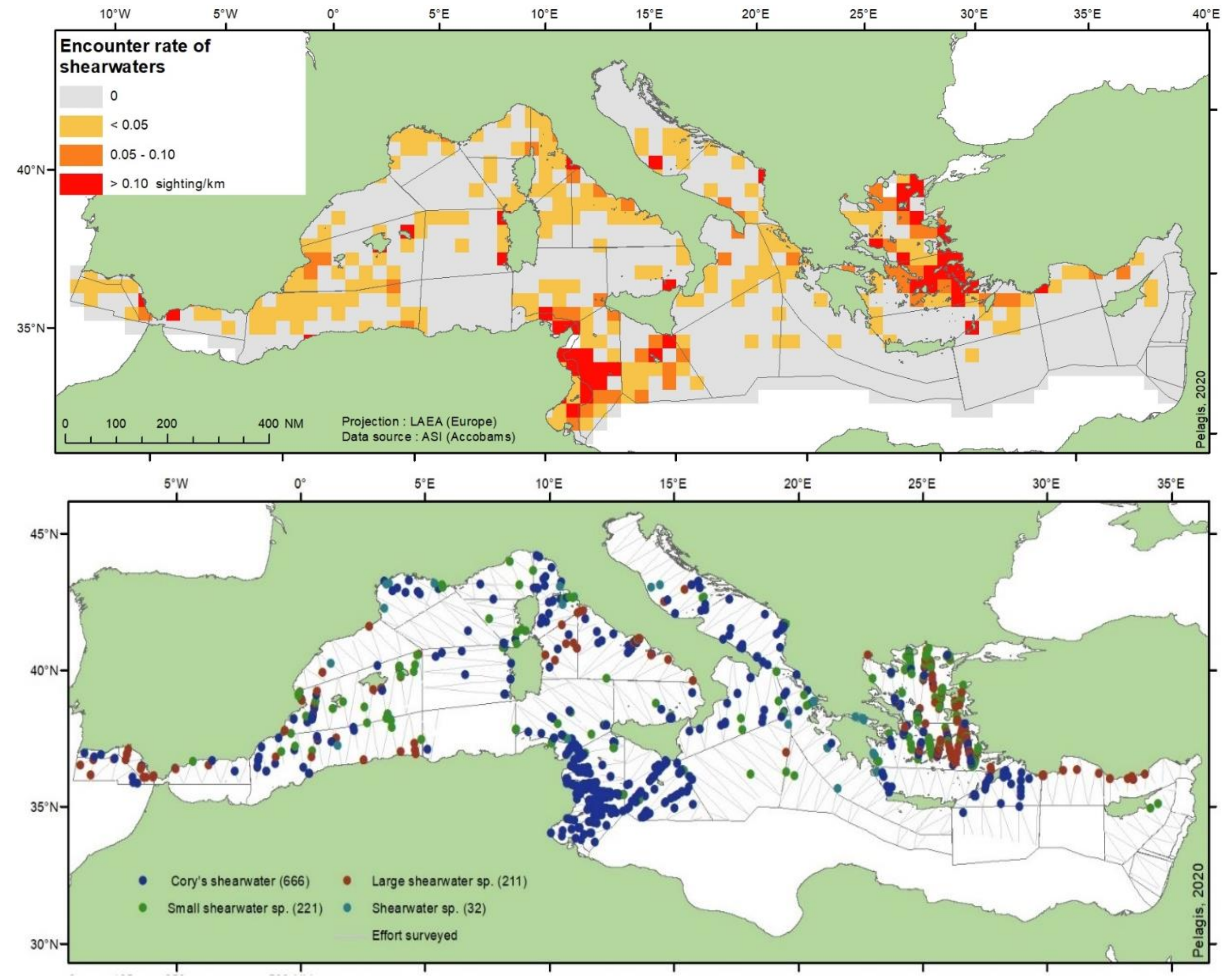


Figure 18. Encounter rate of shearwaters (sighting per km) on a grid of 50x50 km. And effort surveyed with sightings by species (and number of sightings by class) during aerial survey.

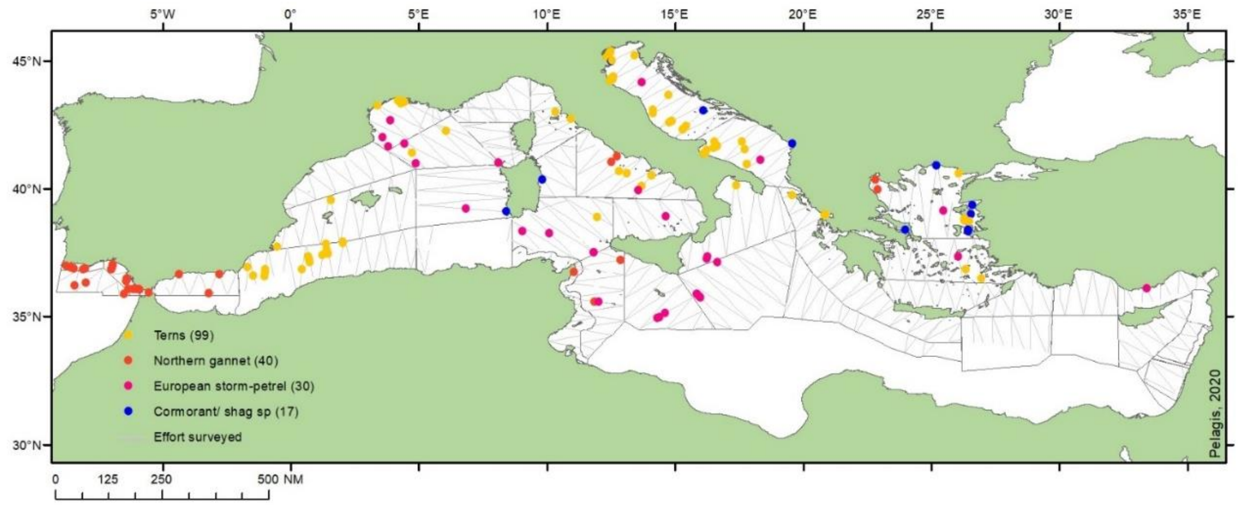


Figure 19. Effort surveyed and sightings of additional species of seabirds during aerial surveys.

II.2.1.3 Sea Turtles

Hard-shelled sea turtles were mostly encountered west of 20°E of longitude, with maximum encounter rate in offshore waters with most on 10 sightings/km (Figure 20). Based on current knowledge on marine turtles' occurrence in the Mediterranean (Casale *et al.,* 2018), we assumed that the vast majority of sighted turtles were loggerhead (*Caretta caretta*), with very few sightings of leatherback turtles (*Dermochelys coriacea*) (Figure 21).

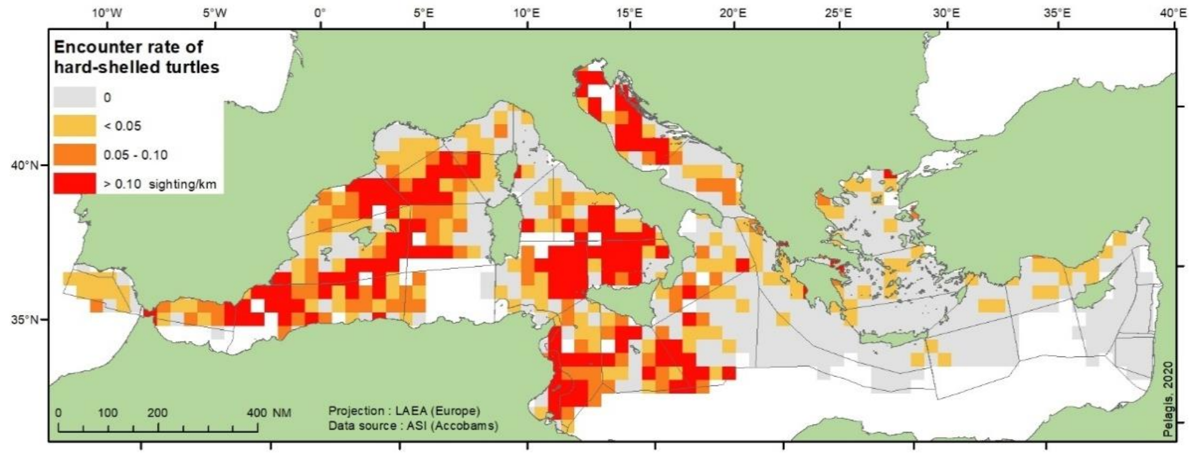


Figure 20. Encounter rate of hard-shelled turtles (sighting per km) on a grid of 50x50 km.

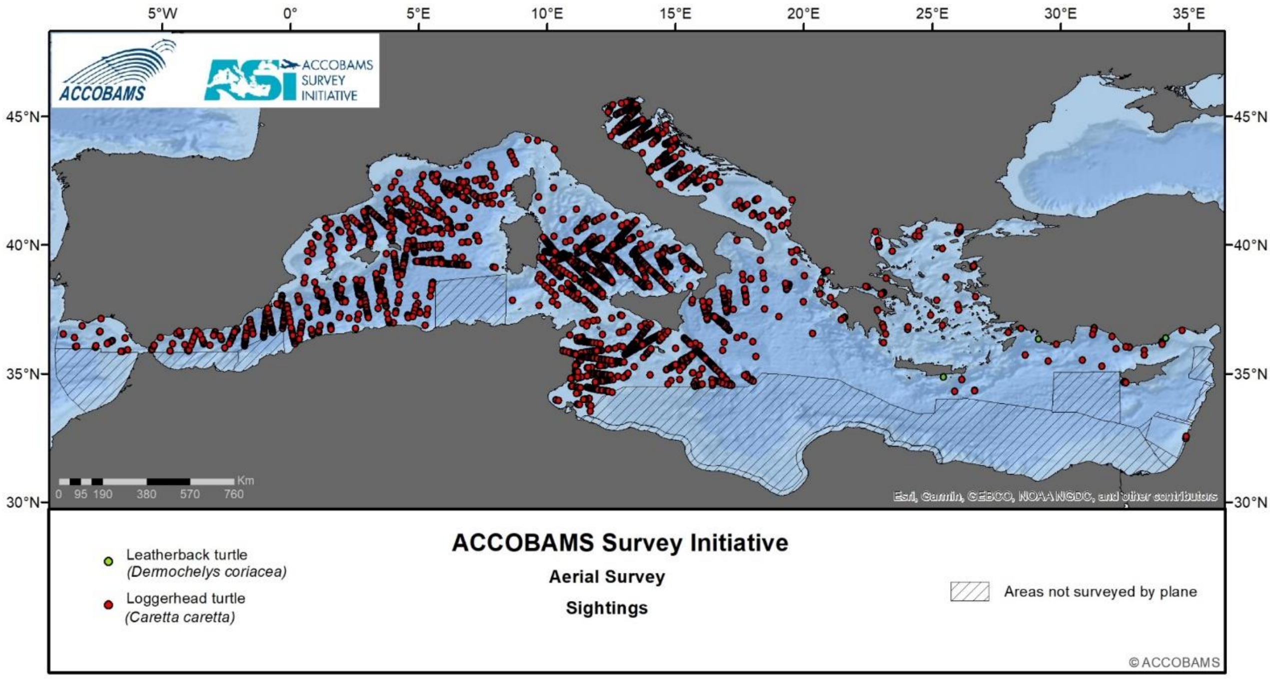


Figure 21. Sea turtle sightings.

II.2.1.4 Elasmobranchs and large fish

Elasmobranchs (rays and sharks) were mostly encountered in the Western basin, West of Tunisia and Adriatic Sea (Figure 22). The majority of elasmobranchs observations were of spinetail devil rays, followed by unidentified shark species. Large fish were mainly ocean sunfish (*Mola mola*), followed by schools of bluefin tunas and bonitos (Figure 23).

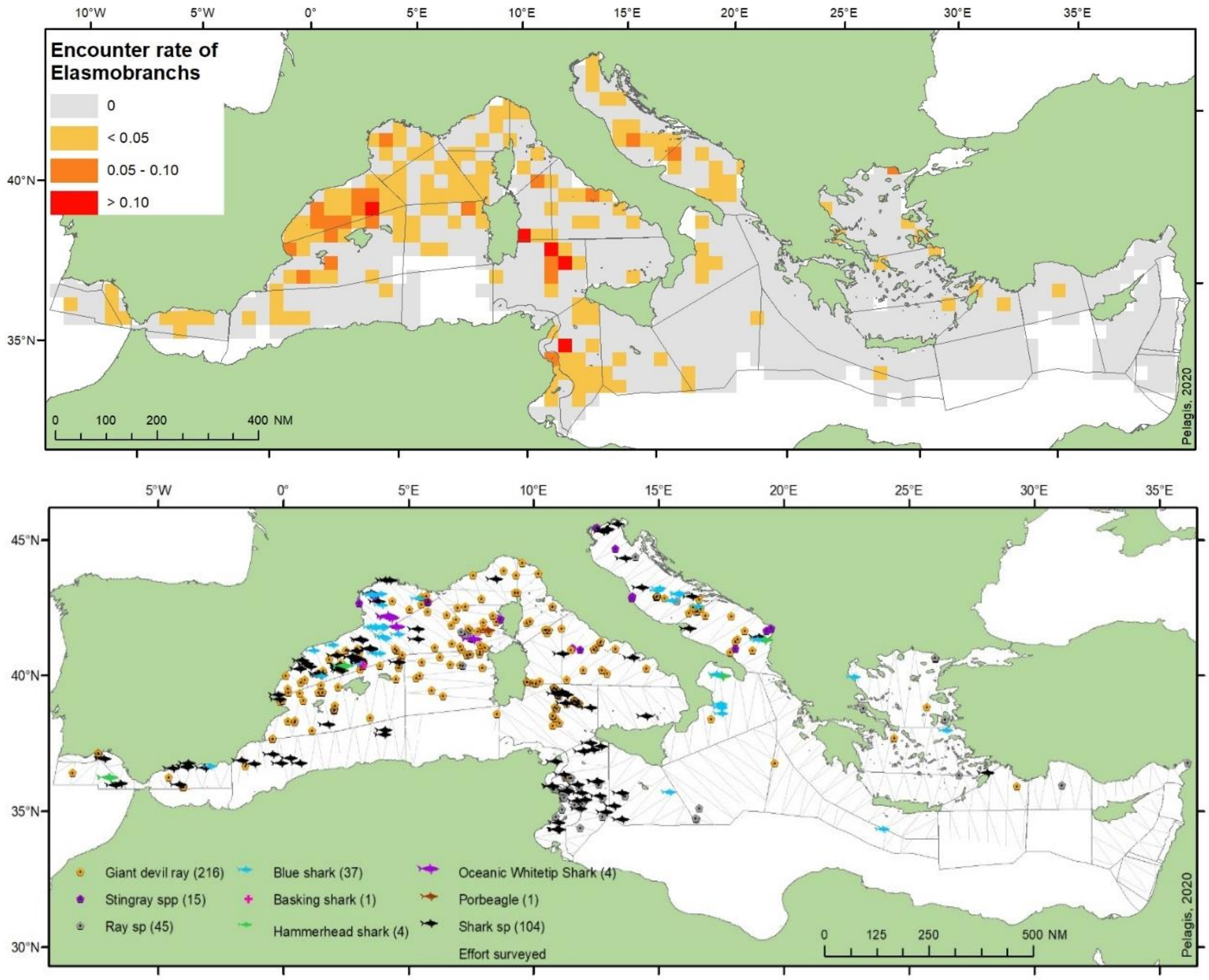
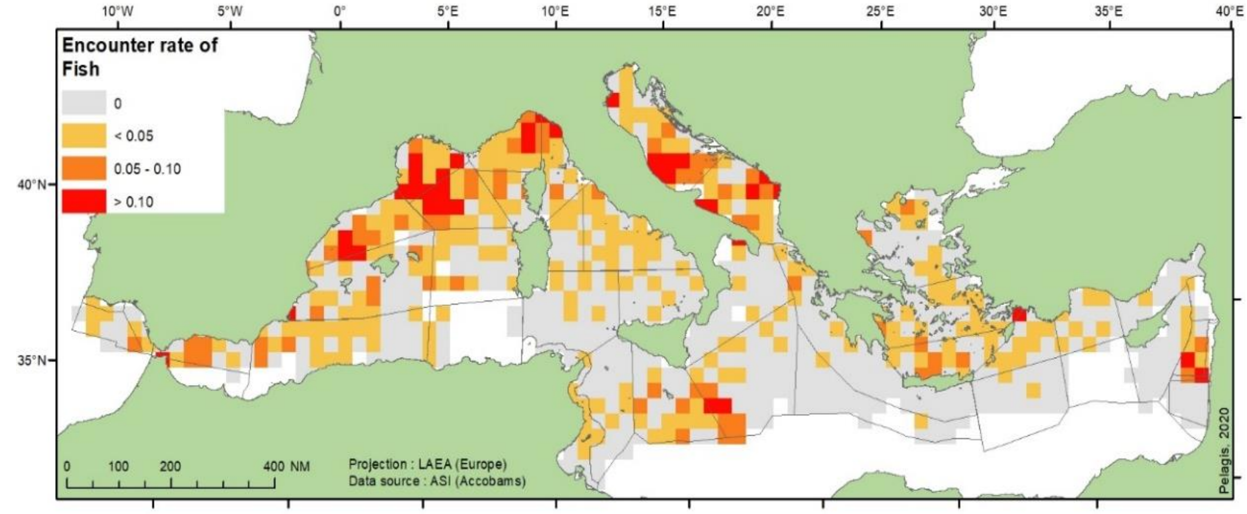


Figure 22. Encounter rate of elasmobranchs (sighting per km) on a 50x50 km grid and effort surveyed and sightings by species during aerial surveys.



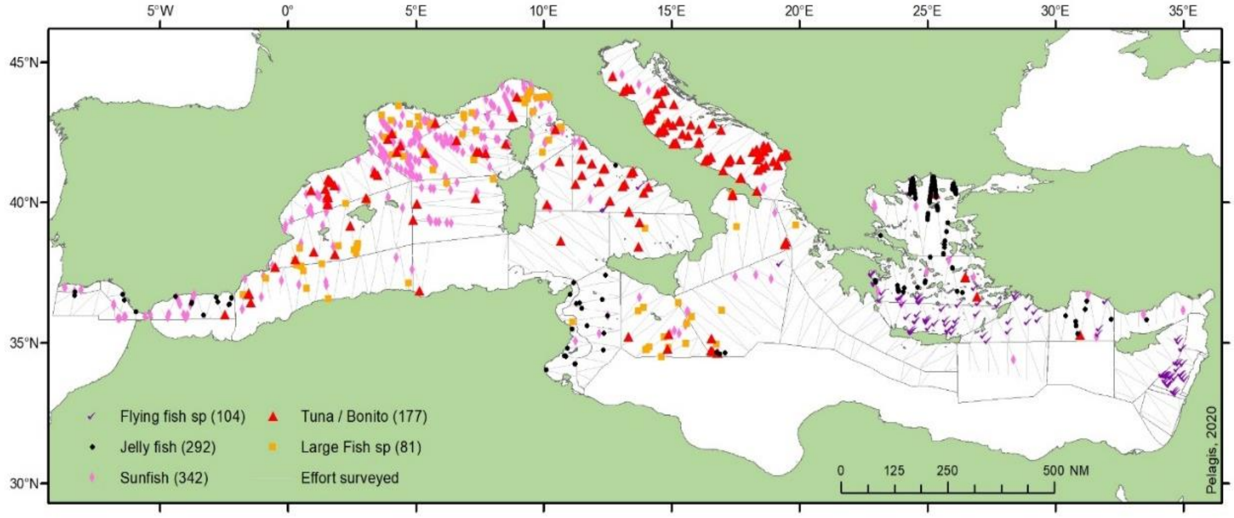


Figure 23. Encounter rate of fish (sightings per km) on a 50x50 km grid and effort surveyed and sightings by species (with number of sightings) during aerial surveys.

II.2.1.5 Human activities and Marine Litter

The data on human activities collected during the survey effort were vessels (registered by different category) sighted within a strip of 500m each side of the plane and marine litter (discussed below). Results of vessels encountered are presented in Figure 24.

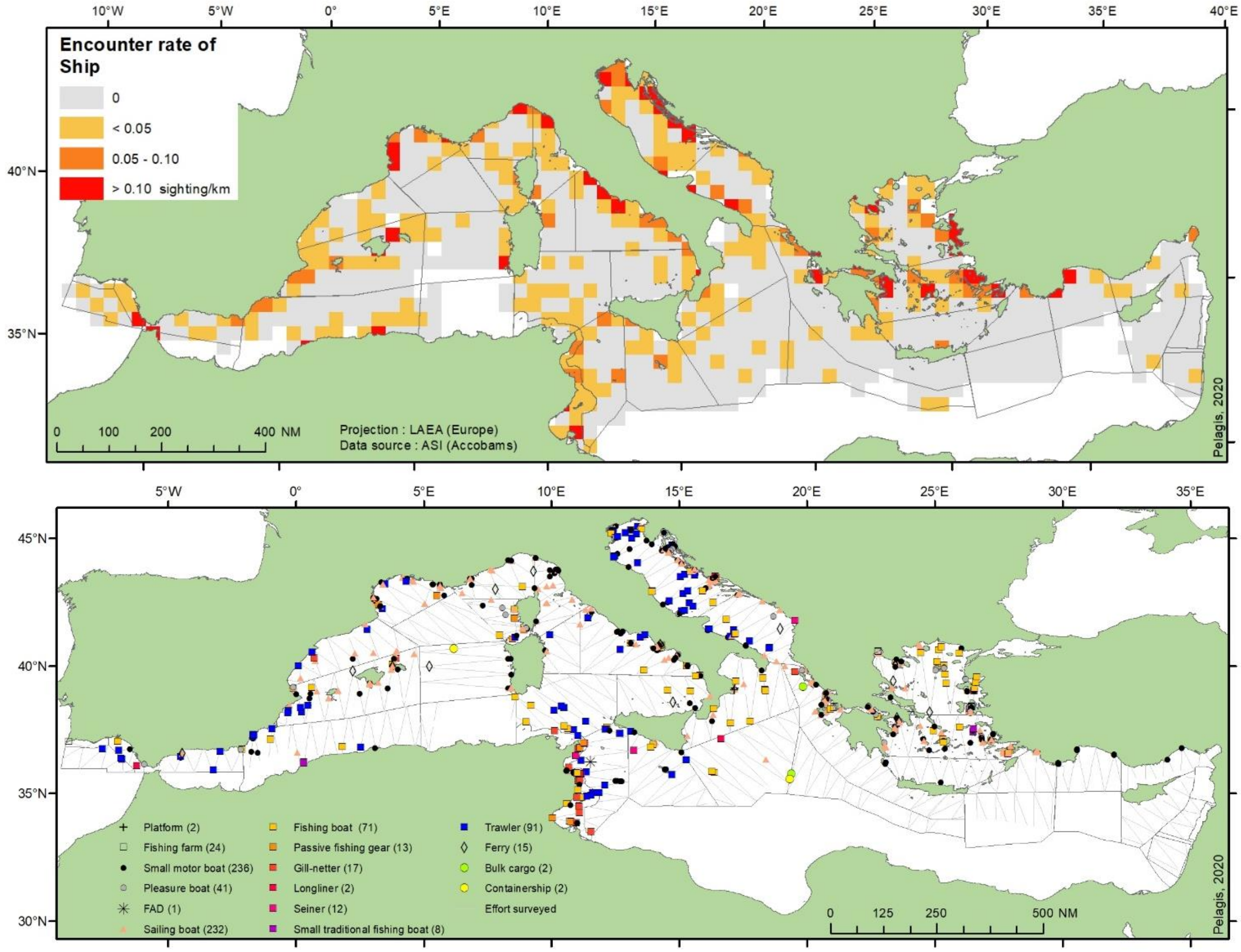


Figure 24. Encounter rate of ship (sightings per km) on a 50x50 km grid and effort surveyed and sightings of human activities by categories during aerial surveys.

Marine litter

Plastic pollution has become one of the biggest environmental concerns of the Anthropocene as it represents a major threat to both wildlife and human health. The ASI data provided a unique opportunity to quantify the problem of anthropogenic debris in the Mediterranean Sea at the basin scale. Floating mega-debris larger than 30 cm in size was recorded from the aircraft (e.g. plastic bags, bottles, tarpaulins, palettes, inflatable beach toys, etc.). Some 41,000 floating mega-debris were recorded in total during the survey with an average encounter (Figure 25) rate of 0.8 mega-debris per km (standard deviation 3.2), ranging between 0 and 110.9 debris per km. More than two thirds of the mega-debris recorded were identified as plastics (68.5%), while 1.7% were fishery debris and 1.9% were anthropogenic wood-trash. The remaining quarter (27.9%) was anthropogenic mega-debris of an undetermined nature. These proportions confirm a large prevalence of plastics in the marine litter of the Mediterranean Sea (Suaria and Aliani, 2014; Fossi *et al.,* 2017; Arcangeli *et al.*, 2018).

Results suggest that highest densities of debris occur in central basin, while numbers decrease in eastern portion of the Mediterranean (Figure 26). When only considering items larger than 30 cm the total number of floating mega-debris was estimated at 2.9 million items, taking into account imperfect detection. Nonetheless, items larger than 30 cm represent only one fourth of the complete load of anthropogenic debris (Suaria and Aliani, 2014). Therefore, when considering all floating items larger than 2 cm, the overall abundance scales up to 11.5 million floating debris (Figure 27). These results will set the scene for identifying high vulnerability areas to plastic debris for marine fauna, and permitting the implementation of adequate strategies to thwart plastic pollution in the Mediterranean Sea and its impact of marine ecosystems.

For further details on the analytical framework and an in-depth presentation and discussion of the results on the presence and abundance of marine debris in the Mediterranean as resulting from the ASI survey, please refer to Lambert *et al.*, 2020.

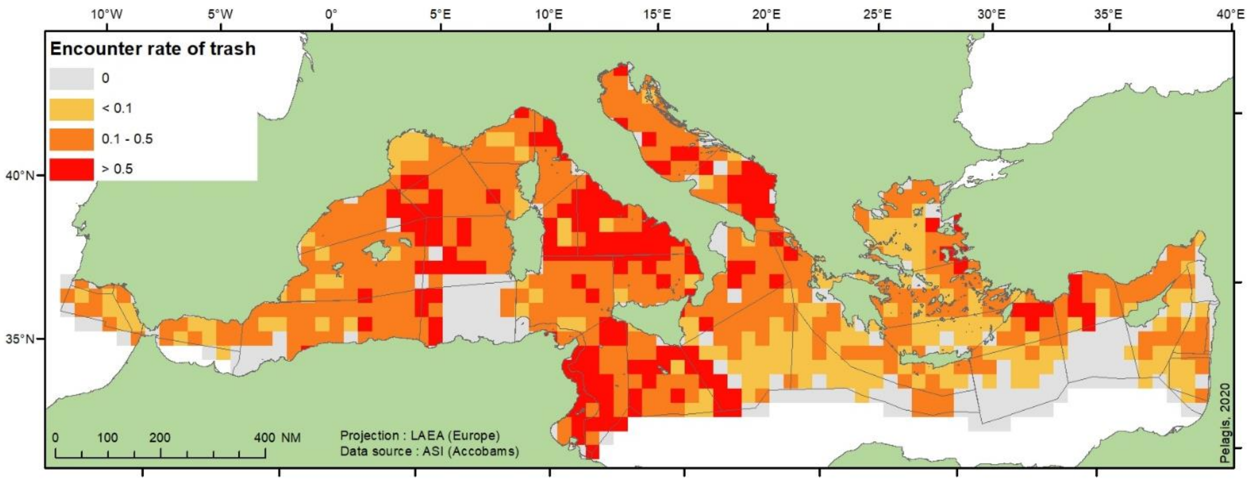


Figure 25. Encounter rate of marine litter (sighting per km) on a 50x50 km grid during aerial surveys.

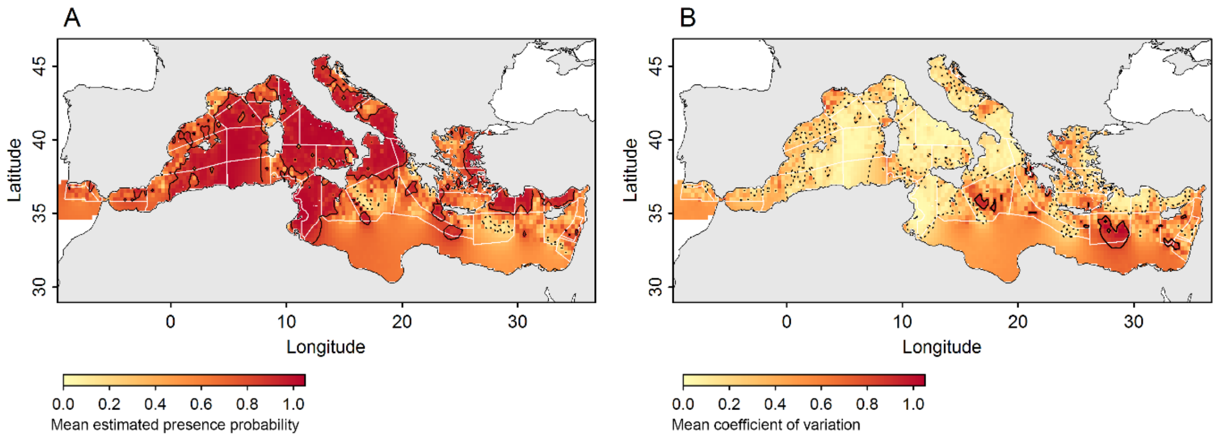


Figure 26. A - Estimated presence probability (posterior mean) of floating mega-debris. B - Uncertainty in estimated presence probability (coefficient of variation). Isolines corresponding to contours of probabilities of 0.2 are shown in dotted black lines and 0.8 contours in solid black lines. ASI survey blocks are shown in solid white lines.

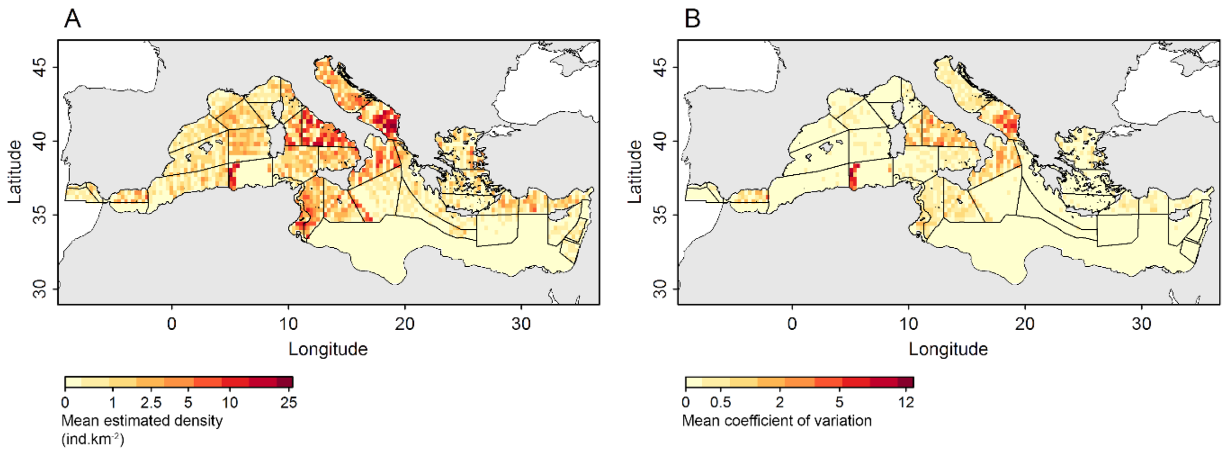


Figure 27. A - Mean estimated densities of floating mega-debris (>30 cm) in number of items per km^2. B - Mean coefficients of variation of estimated densities per cell. ASI survey blocks are shown in solid black lines.

II.2.2 Abundance estimates

The tables presenting the results of both design and model-based analysis for each species are presented as Supplementary Material in Annex II. In these tables, mean group size is the arithmetic mean of the group size in each area or subarea; expected group size is the result of dividing the total estimated number of animals by the total estimated number of groups. The encounter rate of groups is the number of groups detected per every 100km of survey on effort in each area and subarea.

The parameters and results of the final detection functions and the final detection functions and q-q plots for all the species or groups of species of marine mammals are also presented as Supplementary Material in Annex II.

II.2.3 Marine mammals

II.2.3.1 Design-based results

The following Table 8 presents the results of design-based estimates of marine mammals; CVs and CIs are also presented.

Table 8. Summary of design-based estimates of marine mammals (CV: coefficient of variation, 95% CI: Confidence interval at 95%).

Species	**n**	**Abundance**	**CV**	**95% CI**	
Fin whales	44	1,629	0.30	918	2,892
Sperm whales	10	1,443	0.51	562	3,707
All whales	58	3,278	0.29	1,872	5,739
Baleen whales	48	1,770	0.28	1,022	3,065
Risso's dolphins	58	26,154	0.29	14,951	26,154
Bottlenose dolphins	157	63,398	0.17	45,514	63,398
Long finned pilot whales	14	5,459	0.40	2,550	5,459
Large dolphins	241	97,822	0.15	73,444	97,822
Small dolphins	503	735,638	0.13	573,546	735,638
Striped dolphins	260	438,037	0.13	338,680	438,037
Common dolphins	32	65,282	0.40	30,260	65,282
Striped or common dolphins	148	210,191	0.27	125,274	210,191
Cuvier's beaked whale	15	3,157	0.40	1,476	3,157
Beaked whales	19	3,627	0.36	1,813	3,627

II.2.3.2 Model based results

Table 9 shows the parameters and selected covariates for the density surface modelling for each species or group of species.

Table 9. Parameters and selected covariates. edf = estimated degrees of freedom; p = significance of the covariate. Covariates are the same as defined in Table 4.

		Groups/Individuals				Group size			
Species	**Resp. Variables**	**Covariates**	**edf**	**p**	**Deviance explained (%)**	**Covariates**	**edf**	**p**	**Deviance explained (%)**
Fin whales	Indviduals	Lat	1.15	<0.001	45.2				
		Lon	1.16	<0.001					
		mlt_0608	0.89	0.0038					
		distshelf	1.06	<0.001					
Risso´s dolphins	Groups + Grsize	distcanes	0.86	<0.001	19.6	Lat	0.64	0.1	38.9
		Lon	1.04	<0.001		mlt_0608	0.75	0.047	
		mlt_month	0.89	<0.001		ssh_0608	1.81	<0.001	
		CI	1.50	<0.001					
Striped dolphins	Groups + Grsize	Lat-Lon	13.67	<0.001	26.9	Aspect	1.28	0.106	13.2
		depthmax	4.18	<0.001		Lat	0.62	0.126	
						Lon	0.82	0.019	
						SD_sst_month	5.74	<0.001	
Striped or common dolphins	Groups + Grsize	Lon	5.62	<0.001	27.9	Lat-Lon	1.62	<0.001	7.8
		sst_0608	1.01	<0.001					
		distslope	0.93	<0.001					
Small dolphins	Groups + Grsize	distescar	0.94	<0.001	27.3	Lat	0.32	0.248	4.6
		Lat	1.27	<0.001		Lon	1.03	<0.001	
		Lon	6.23	<0.001					
		depthmax	3.99	<0.001					
Bottlenose dolphins	Groups + Grsize	Lat-Lon	20.06	<0.001	15.3	depthmax	2.5	0.004	18.6
		CI	2.39	<0.001		distcany	0.66	0.079	
						mlt_0608	0.72	0.069	
						sst_0608	0.92	<0.001	

The following figures present the results of model-based abundance estimates for those species of cetaceans (Figure 28-33) with an adequate number of sightings, which allows acceptable CVs and CIs. The maps present predicted number of animals per 100 km^2.

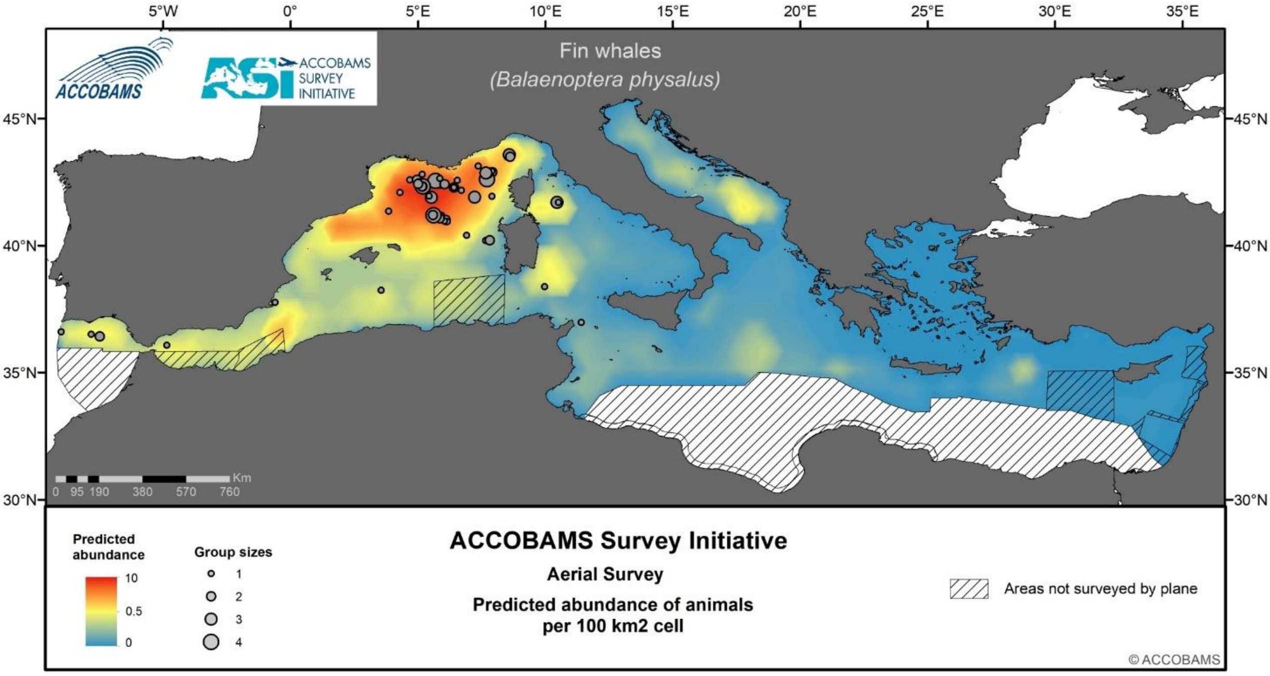


Figure 28. Predicted abundance of fin whales.

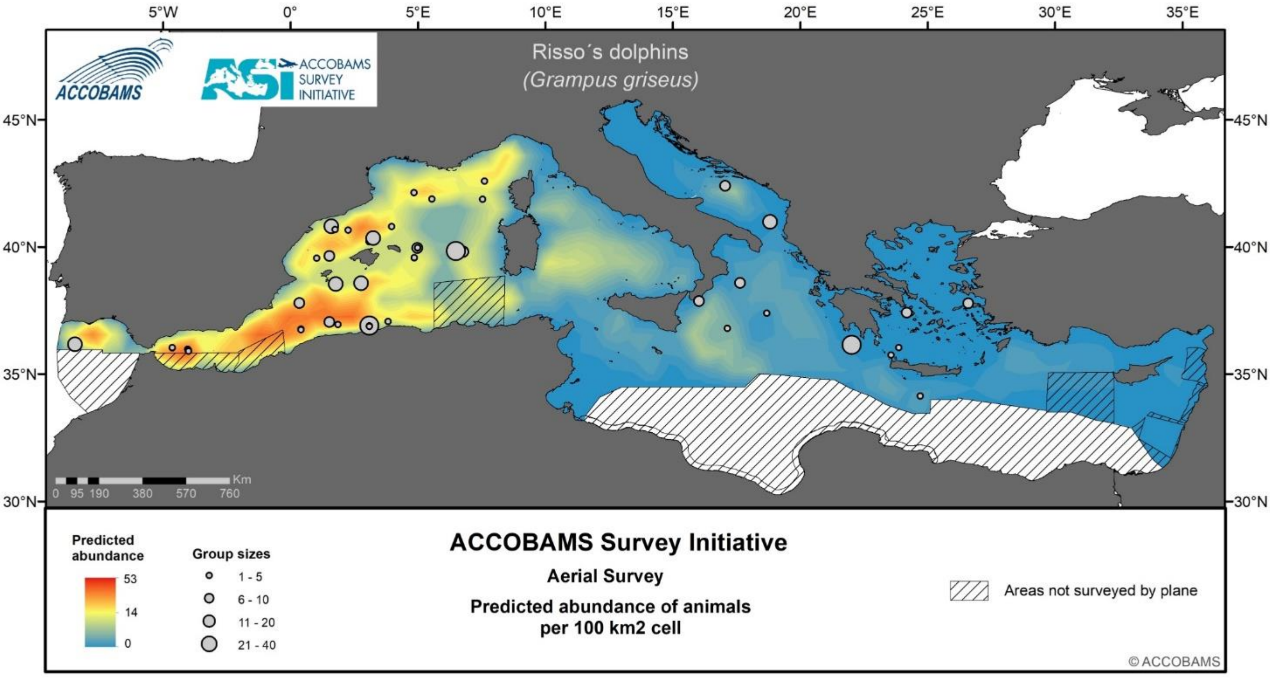


Figure 29. Predicted abundance of Risso’s dolphins.

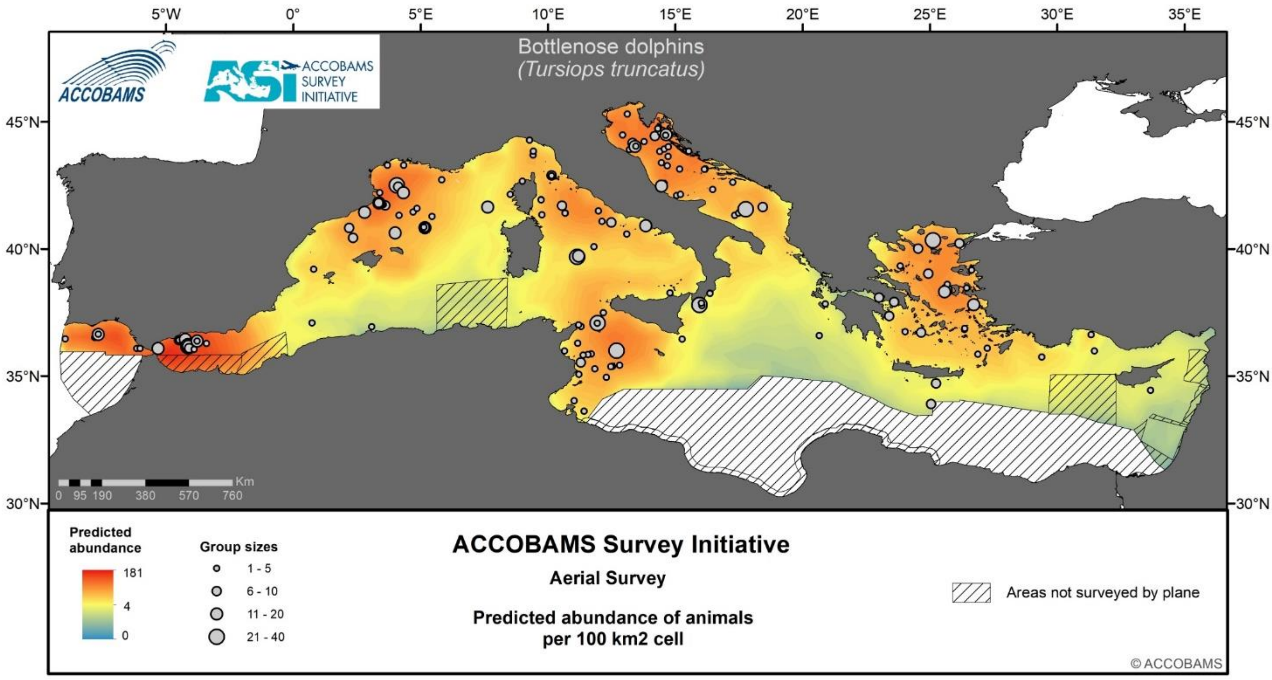


Figure 30. Predicted abundance of bottlenose dolphins.

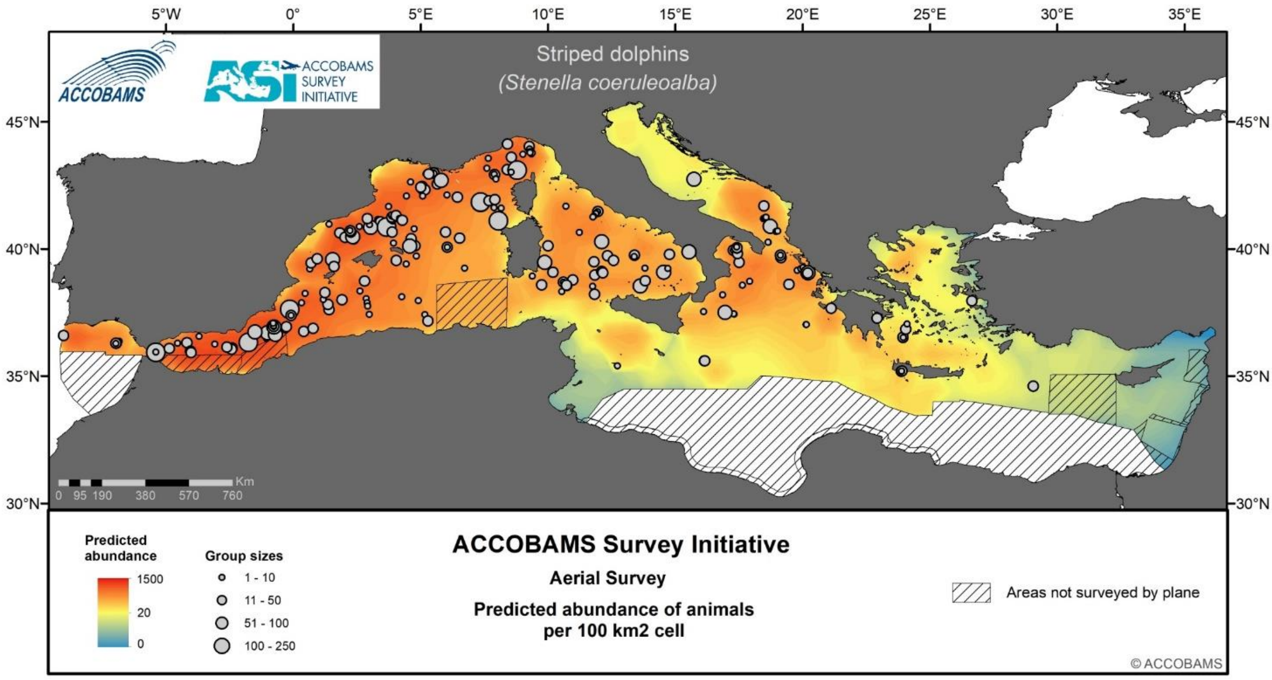


Figure 31. Predicted abundance of striped dolphins.

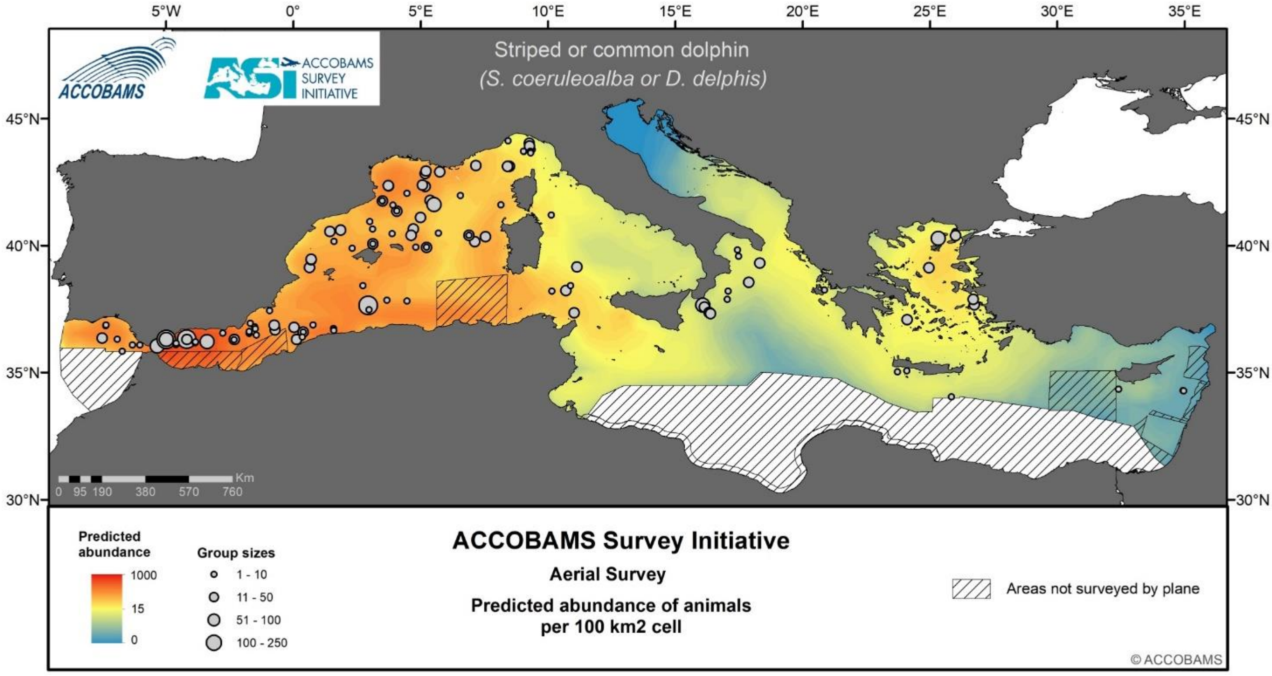


Figure 32. Predicted abundance of undetermined striped or common dolphins.

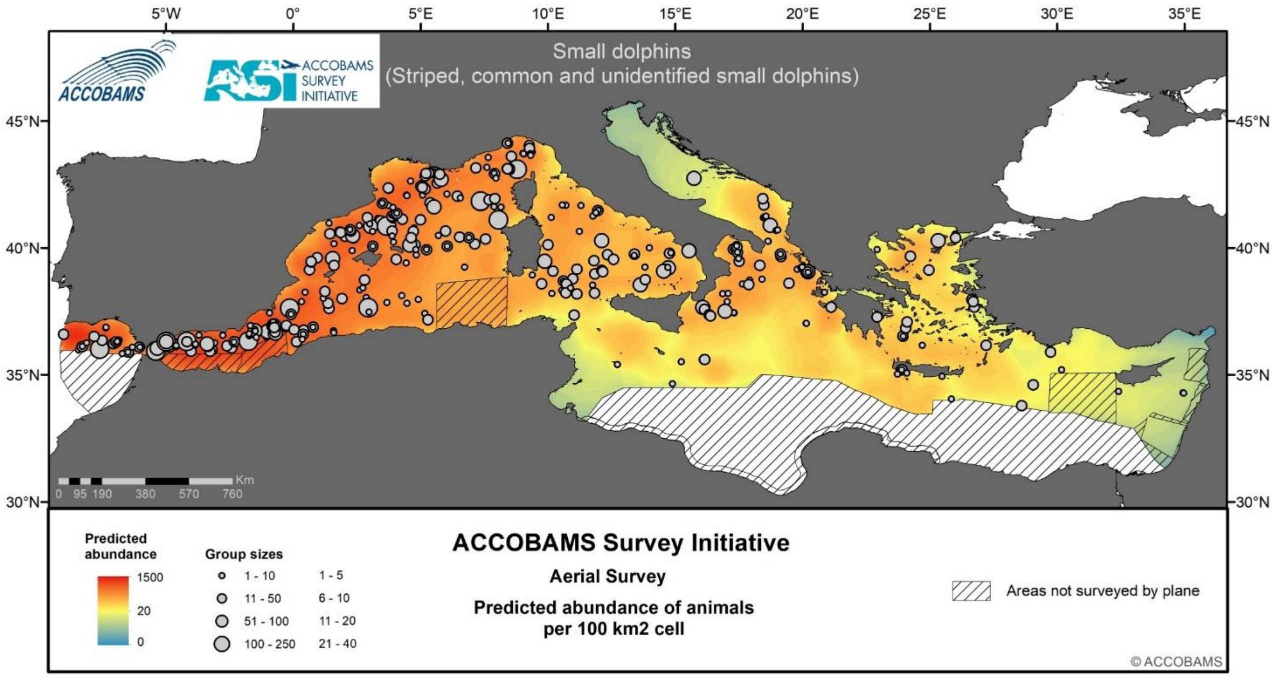


Figure 33. Predicted abundance of small dolphins (striped, common dolphins).

II.2.4 Seabirds

The following Table 10 presents the results of design-based estimates of seabirds, CVs and CIs are also presented.

Table 10. Summary of design-based estimates of seabirds.

Species	**n**	**Abundance**	**CV (%)**
Cory shearwater	1895	165,669	32.78
Large shearwaters	2522	230,580	27.12
Small shearwaters	1736	118,067	35.91
Terns	142	15,515	131.44
Storm petrel	41	3,474	345.17
Small gull	1,239	289,672	143.54
Large gulls	5,107	577,854	18.4

II.2.4.1 Model based results

Table 11 shows the parameters and selected covariates for the density surface modelling for each species or group of species.

Table 11. Parameters and selected covariates. edf = estimated degrees of freedom; p = significance of the covariate. Covariates are the same as defined in Table 4.

		Groups/Individuals				Group size			
Species	**Resp. Variables**	**Covariates**	**edf**	**p**	**Deviance explained (%)**	**Covariates**	**edf**	**p**	**Deviance explained (%)**
All shearwaters	Individuals	Lat	7.26	<0.001	42.4				
		SD_sst_0608	4.64	<0.001					
		chl_0608	2.42	<0.001					
		depthmean	3.59	<0.001					
		distcanes	5.64	<0.001					
		mlt_0608	3.83	<0.001					
		ssh_0608	0.99	<0.001					
		sst_0608	5.21	<0.001					
Cory shearwater	Individuals	Lat	6.34	<0.001	47.8				
		Lon	8.50	<0.001					
		SD_sst_0608	5.01	<0.001					
		chl_0608	5.35	<0.001					
		depthmean	3.58	<0.001					
		distcanes	5.23	<0.001					
Large gulls	Groups + Grsize	Lat	1.29	<0.001	46.3	chl_0608	8.04	<0.001	31.9
		Lon	7.11	<0.001		dist100	3.43	<0.001	
		ssh_month	1.05	<0.001		mlt_month	6.74	<0.001	
		chl_0608	0.95	<0.001		ssh_0608	5.97	<0.001	
		depthmean	4.71	<0.001		sst_month	1.08	<0.001	

		Groups/Individuals				Group size			
Species	**Resp. Variables**	**Covariates**	**edf**	**p**	**Deviance explained (%)**	**Covariates**	**edf**	**p**	**Deviance explained (%)**
		distcanes	3.34	<0.001					
Large shearwaters	Individuals	aspect	6.80	<0.001	45.4				
		Lat	7.53	<0.001					
		Lon	7.93	<0.001					
		ssh_month	0.98	<0.001					
		chl_0608	5.78	<0.001					
		depthmean	3.12	<0.001					
		SD_sst_0608	5.49	<0.001					
		sst_0608	4.51	<0.001					
Small gulls	Groups + Grsize	chl_0608	0.97	<0.001	31.9	Lat-Lon	22	<0.001	47.2
		Lat	4.75	<0.001					
		Lon	7.98	<0.001					
		ssh_0608	1.01	<0.001					
		depthmean	3.20	<0.001					
Small shearwaters	Individuals	chl_0608	2.03	<0.001	43.2				
		Lat	0.96	<0.001					
		ssh_month	0.86	<0.001					
		dist0	3.61	<0.001					
		mlt_0608	2.92	<0.001					
		SD_sst_0608	0.89	<0.001					
		sst_0608	4.09	<0.001					
Terns	Individuals	Lat-Lon	20.15	<0.001	43.7				
		dist1000	1.03	<0.001					

II.2.5 Turtles

Overall, 3,992 sea turtle sightings were recorded, and the abundance was estimated at 313,455 individuals with a CV of 4.82%.

II.2.5.1 Model based results

Table 12 shows the parameters and selected covariates for the density surface modelling for each species or group of species.

Table 12. Parameters and selected covariates. The meaning of the covariates can be consulted in Table 4; edf = estimated degrees of freedom; p = significance of the covariate.

		Groups/Individuals			
Species	**Resp. Variables**	**Covariates**	**edf**	**p**	**Deviance explained (%)**
Turtles	Individuals	Lat	7.96	<0.001	38.7
		Lon	8.51	<0.001	
		dist0	4.36	<0.001	
		distcanes	5.52	<0.001	
		mlt_0608	3.13	<0.001	
		SD_sst_0608	4.15	0.011	

The following map presents predicted abundance for turtles over the surveyed area (Figure 34).

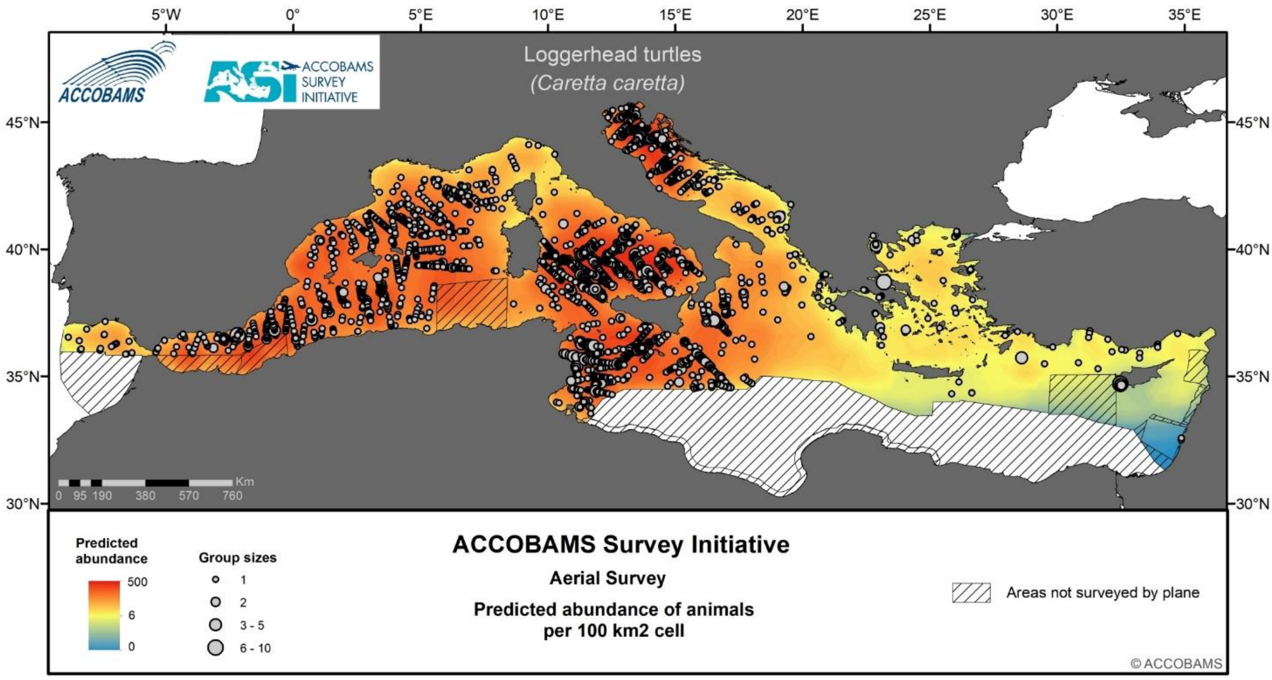


Figure 34. Predicted abundance of loggerhead turtles.

II.2.6 Fish and elasmobranchs

The following Table 13 presents the results of design-based estimates of fish and elasmobranchs, CVs and CIs are also presented.

Table 13. Summary of design-based estimates of fish and elasmobranchs.

Species	n	Abundance	CV	95% CI	
All sharks	144	24,019	0.23	15,198	37,959
Blue sharks	36	3,984	0.21	2,660	5,967
All rays	261	32,917	0.14	25,024	43,300
Mobula	210	25,479	0.13	19,490	33,308
Rays no mobula	51	7,438	0.39	3,522	15,710
Tuna	166	442,379	0.39	207,318	943,957
Sword fish	233	20,462	0.11	16,417	25,504
Small fish	144	254,862	0.42	112,294	578,433

The final detection functions and q-q plots for all the groups of species of elasmobranchs and fish are presented as Supplementary Material in Annex II.

II.2.6.1 Model based results

Table 14 shows the parameters and selected covariates for the density surface modelling for each species or group of species.

Figures 35 to 38 shows the predicted abundance for fish and elasmobranchs over the surveyed area.

Table 14. Parameters and selected covariates. The meaning of the covariates can be consulted in Table 6; edf = estimated degrees of freedom; p = significance of the covariate.

		Groups/Individuals				Group size			
Species	**Resp. Variables**	**Covariates**	**edf**	**p**	**Deviance explained (%)**	**Covariates**	**edf**	**p**	**Deviance explained (%)**
All rays	Individuals	Lat-Lon	19.27	<0.001	33.83				
		mlt_month	3.83	<0.001					
		ssh_0608	5.89	<0.001					
		sst_0608	4.58	<0.001					
Spinetail devil ray	Individuals	Lat	3.58	<0.001	29.71				
		Lon	1.10	<0.001					
		ssh_0608	4.79	<0.001					
Sharks	Individuals	Lat	6.18	<0.001	38.81				
		Lon	6.99	<0.001					
		distshelf	0.96	<0.001					
		mlt_0608	0.88	<0.001					

Small ray	Individuals	Lat	0.91	<0.001	34.21				
		dist2000	3.19	<0.001					
		ssh_0608	3.45	<0.001					
Sunfish	Individuals	Lat-Lon	21.12	<0.001	36.36				
Swordfish	Individuals	distescar	4.48	<0.001	20.86				
		Lat	0.95	<0.001					
		Lon	7.01	<0.001					
		CI	1.06	<0.001					
		SD_sst_month	0.91	<0.001					
Tuna	Groups + Grsize	Lat-Lon	22.55	<0.001	31.37	Lat-Lon	23.7	<0.001	87.81

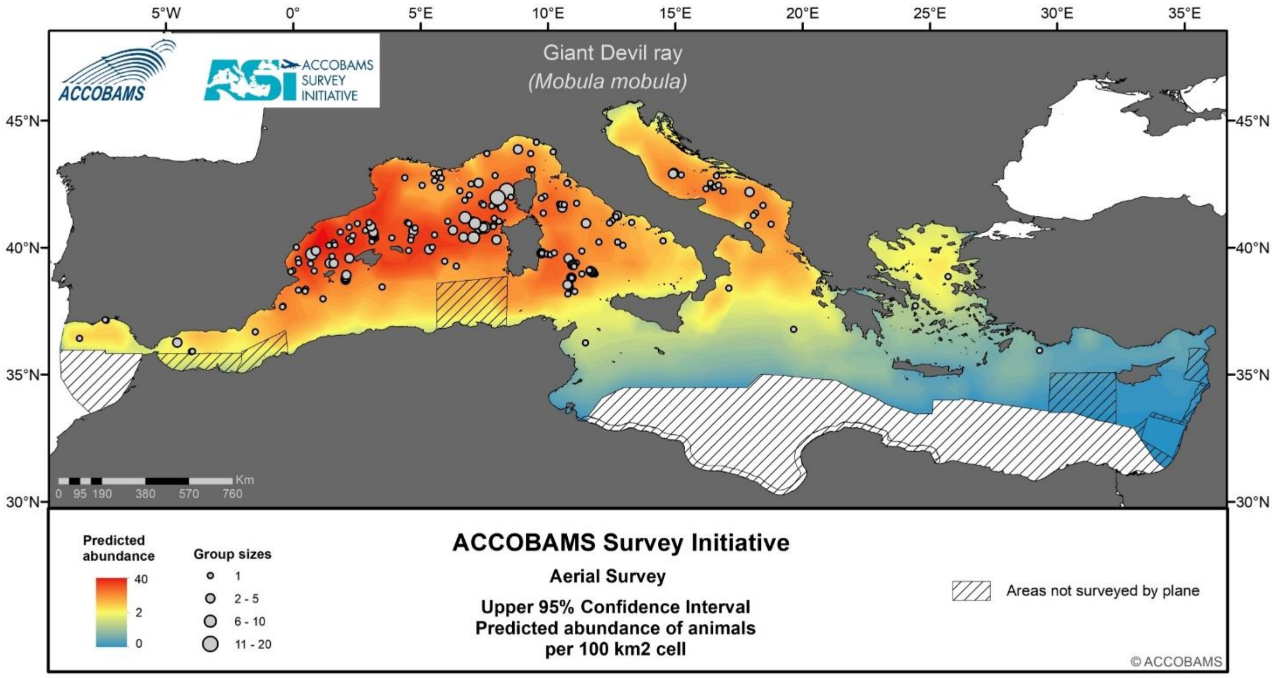


Figure 35. Predicted abundance of spinetail devil rays.

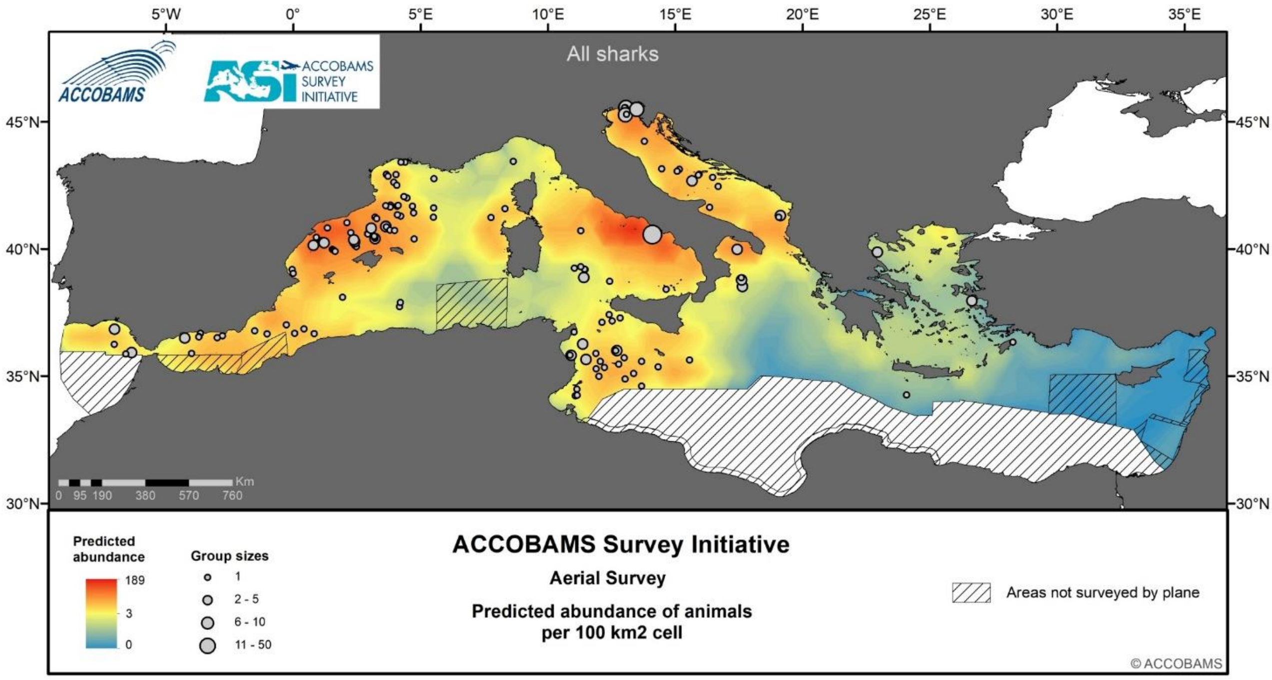


Figure 36. Predicted abundance of shark specimens.

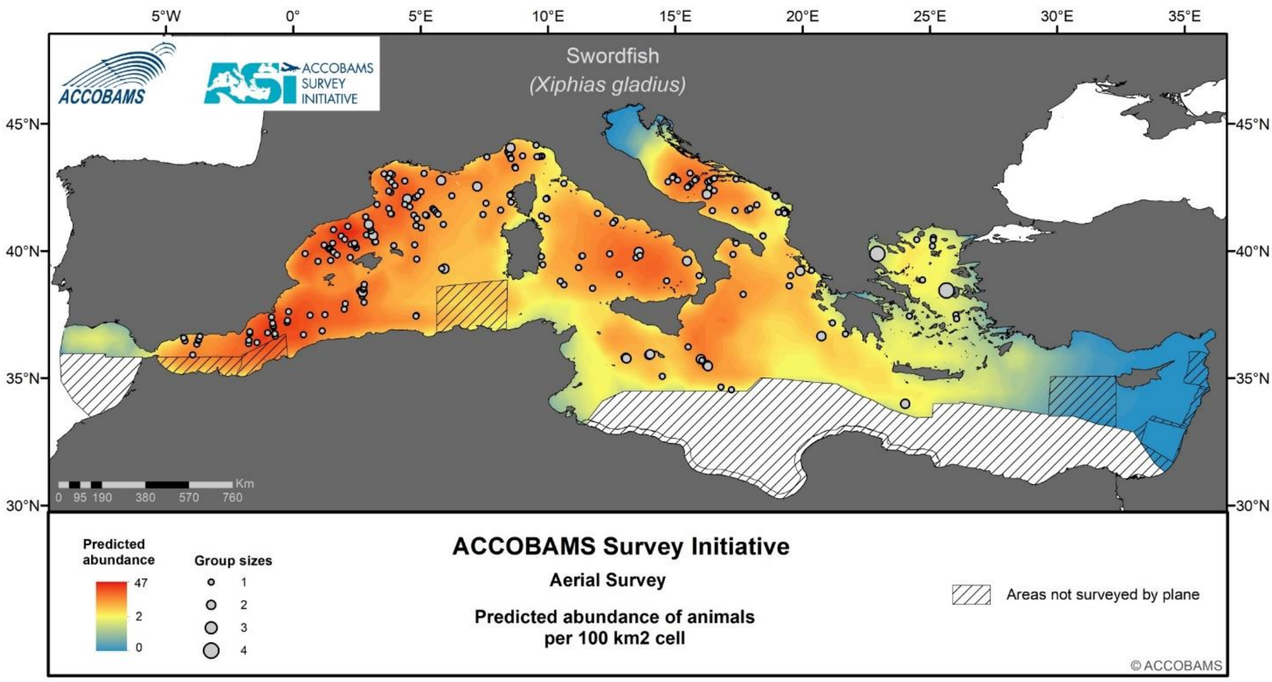


Figure 37. Predicted abundance of swordfish.

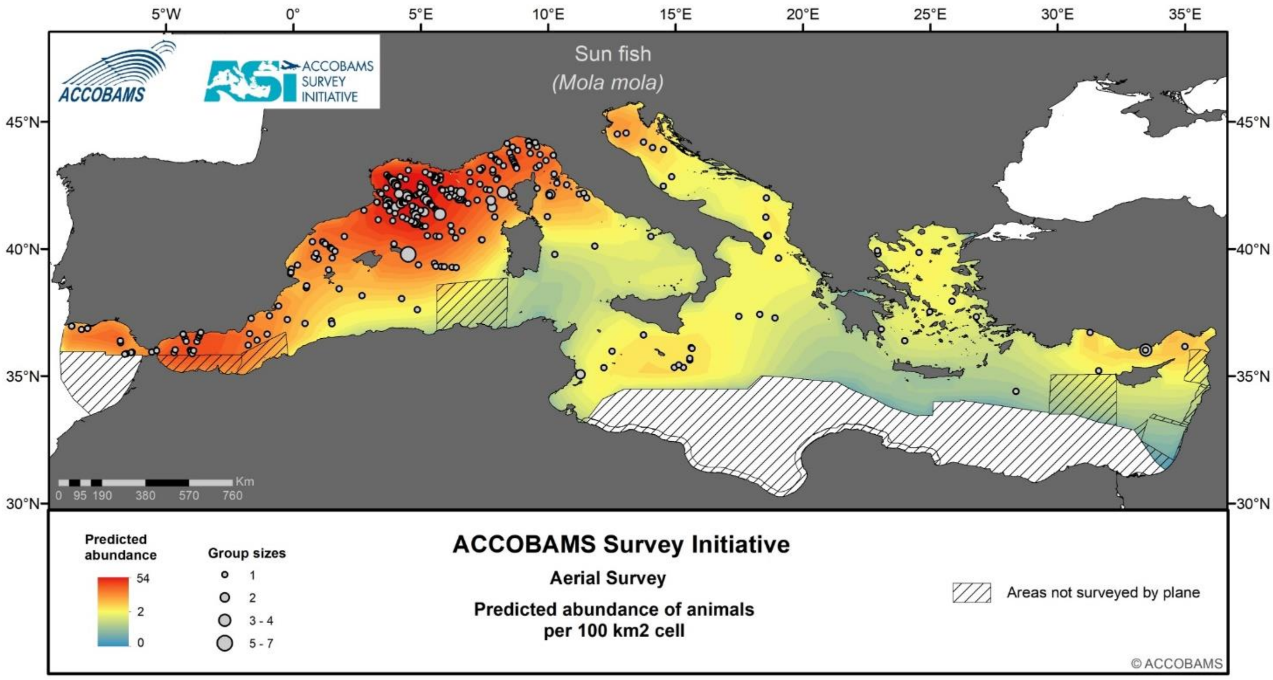


Figure 38. Predicted abundance of ocean sunfish.

II.2.7 Archiving of Survey Data

For the aerial surveys, data were validated by the team after each flight and checked by each team leader. At the end of the survey, all flights were computed by computers system and general covered area was checked, to be sure to store all the effort collected.

Collected data have been stored into dedicated DropBox folders which were created and shared with team leaders. Every day, after data validation, the DropBox folder was updated, and the Scientific Coordinator downloaded the files for that specific day. Data were then saved by teams and coordinator in two separate hard drives and copy of the files was sent to Pelagis, at the University of La Rochelle, for extra storage and for data preparation for the analysis. Data have then been merged into GIS shape files and MS Excel files, for plotting and descriptive statistics.

All pre-treated datasets have been archived with ACCOBAMS. Part of the datasets are made available for the widest possible use for conservation related purposes, in accordance to Terms of use[5] developed by ACCOBAMS and can be downloaded on line on the ACCOBAMS Website[6]. The Survey effort information associated with the ASI datasets is to be requested to the ACCOBAMS Permanent Secretariat.

[5] https://www.accobams.org/asi-data-terms-and-conditions/
[6] https://accobams.org/asi-data-presentation/

II.3. SYNTHESIS AND GENERAL CONSIDERATIONS

The aerial component of the ACCOBAMS Survey Initiative provided coverage of a large portion of the Mediterranean Sea over a relatively short time, allowing robust estimates of density and relative abundance for most cetacean species, some large vertebrates and seabirds, as well as marine litter and vessels. This represents an unprecedented effort at the Mediterranean level and sets the baseline level for future effort which will allow, in the medium to long term, to assess trends in abundance, density and distribution.

The abundance estimates provided in this report are underestimates of the real numbers, in that they have not been corrected for availability or perception biases. However, these biases can be corrected when data is available and estimates can, therefore, be corrected retrospectively. Perception bias for large whales is thought to be relatively small. For example, (Heide-Jørgensen *et al*., 2010) estimated perception bias to be around 0.86 for fin whales from an aerial survey off West Greenland using a different aeroplane, but they did not provide an estimate for availability bias. Similarly, (Palka, 2006) suggested that perception bias will also be small for larger groups of dolphins (mean group sizes for the present surveys were 8 in winter and 14 in summer). Gomez de Segura *et al.* (2006) provided an availability bias correction factor for striped dolphins of around 0.7.

In this study, availability bias (a) was estimated for fin whales using information on surfacing and dive times from (Jahoda *et al.,* 2003) and the method of (Laake *et al*., 1997), corrected for an average group size (g) of 1.6 whales, using the equation $a_{corrected} = 1 - (1 - a)^g$.

Accordingly, the value of corrected availability bias obtained was 0.538 (CV=0.13).

Further indication of the extent by which the estimates may be negatively biased, can be derived from information on correction factors arising from a similar effort in European Atlantic waters (SCANS-III). During the SCANS-III survey, the circle-back or “racetrack” method of (Hiby, 1999) was used to collect data from which correction could be made for animals missed on the transect line (Hammond *et al.*, 2017). In this approach, on detecting a group of animals, the aircraft circles back to resurvey a defined segment of transect, thus providing information on whether or not a group was resighted. These data are then analysed in a similar way to data collected on two platforms on a ship survey to estimate the probability of detecting a group of animals on the transect line, known as *g(0)*. The same method was used in SCANS-II (Hammond *et al.,* 2013) and an equivalent method developed for tandem aircraft (Hiby and Lovell, 1998) was used in SCANS (Hammond *et al.,* 2002). Further details regarding implementation of this method can be found in (Scheidat *et al.,* 2008).

In previous surveys, the circle-back method has only been used for harbour porpoise. In SCANS-III, it was also implemented for the common minke whale and for some delphinids (including bottlenose, common, striped and Risso’s dolphin).

The following Table 15 presents estimates of *g(0)* for harbour porpoise, all dolphin species combined and minke whale obtained from the SCANS-III aerial surveys, for good and moderate sighting conditions classified based on sea conditions, water turbidity and glare (Hammond *et al*. 2017). Note that these estimates of *g(0)* should correct for both availability and perception bias.

Table 15. Estimates of *g(0)* for harbour porpoise, all dolphin species combined and minke whale obtained from the SCANS-III aerial surveys, for good and moderate sighting conditions classified based on sea conditions, water turbidity and glare (Hammond *et al*., 2017).

	g(0)	
Conditions	Good (CV)	Moderate (CV)
Harbour porpoise	0.364 (0.16)	0.279 (0.17)
Dolphins (all species)	0.805 (0.13)	0.414 (0.14)
Minke whale	0.302 (0.42)	

All of our estimates are negatively biased because we did not account for visible whales that were missed by observers (perception bias) or whales that were submerged and invisible to observers (availability bias). Correction for such biases, whilst important to obtain estimates of absolute abundance, is not essential for trend analyses (for which the estimates can be treated as indices of abundance), provided that it can be assumed that the levels of bias remain constant over time. This requires surveys to be conducted using equivalent aircraft, observers and field protocols.

The results and maps presented in this report, alongside the maps, figures and tables available in the annexes attached to this document are essential to draw some important conclusions on the occurrence and distribution of the several species encountered during the aerial component of the survey. Nonetheless, it is inherently difficult to translate these more direct outcomes of the ASI into conservation and management recommendations to the wider expert community. In this context, ASI sub-regional analytical workshops have been and still are being organised together with a final workshop, with the aim of gathering local scientists, conservationists, experts and stakeholders to jointly address conservation and management issues and initiatives.

It is important to note that basin-wide estimates for cetaceans and other mega vertebrates in the Mediterranean Sea and ACCOBAMS area have never been obtained before, thus making comparisons with existing knowledge, for some species and geographic areas, difficult. Most of the past effort in the region has been allocated along coastal areas and despite research on cetaceans has been going on for well over three decades, several portions of the Mediterranean have never or very minimally monitored in the past (Mannocci *et al.*, 2018a). Some of these areas remain unexplored from this point of view also with the ASI in place. In fact, some portions of the easternmost and southernmost Mediterranean have not been surveyed by plane nor vessel due to logistic constrains and lack of research permits. Accordingly, in these areas it is still difficult to accurately depict the current situation in terms of occurrence, distribution and abundance of cetacean populations therein. On the other hand, in the western Mediterranean Sea, at sea monitoring has been more substantial, in particular during the last decade, with several wide scale survey taking place in particular in its central and north-western sectors (e.g. Gomez de Segura *et al.*, 2006; Fortuna *et al.*, 2014; Lauriano *et al.*, 2014, 2017; Notarbartolo di Sciara *et al.*, 2015; Laran *et al.*, 2017b; Panigada *et al.*, 2017b). Despite pre-existing knowledge in these areas, direct comparisons cannot be made with the ASI results at the moment and further analysis are necessary to eventually evaluate assess local trends.

Generally, for all observed species for which abundance and density were estimated, values tend to be higher in the western portion of the Region. In fact, as we can also infer from encounter rate values calculated at the taxon level (Figure 8), this is particularly true for cetaceans, elasmobranchs and sea turtles, while for birds high numbers were reported also in the eastern basin in particular in the Aegean Sea. Seabirds showed maximum values in particular along coastal areas, east of Tunisia, as well as in the Adriatic and Aegean Seas.

Hard-shelled sea turtles were mostly encountered in offshore waters of the western basin, south east of the Strait of Messina and in the northern sector of the Adriatic Sea; finally, large fish and elasmobranchs were primarily encountered north of the Balearic Islands to the Gulf of Lions or south of the Adriatic Sea.

Concerning cetaceans, overall, small delphinids were the most abundant functional group of cetaceans ((n=764,700; 95% CI=595,000-983,000), followed by large delphinids (n=110,000; 95% CI=79,000-153,000) and all whales (n=3,300; 95% CI=1,900-5,700)

Further considerations on cetaceans' estimates are provided below by species.

II.3.1 Striped dolphin

The aerial component of the ASI proves that, amongst small delphinids, striped dolphins are confirmed to be the most abundant species of cetacean in the Mediterranean Sea and the extended ACCOBAMS region (n=425,724; 95% CI= 328,694-551,397) in agreement with previous research (e.g., Forcada *et al*., 1994, 1995; Cotté *et al*., 2010; Panigada *et al.,* 2017b). The species has been observed primarily in the offshore waters of the Mediterranean where the largest groups were also observed, indicating a strong preference for deep pelagic waters (e.g., Azzellino *et al*., 2008). Despite sightings of this species were recorded across the entire study area, a strong gradient is apparent with density and abundance being higher in the western portion of the Basin. The highest densities were obtained for the Alborán Sea, the Balearic Islands, Gulf of Lion and the waters of the Pelagos Sanctuary. The Tyrrhenian Sea, the Moroccan and Algerian plateau and the waters of the Ionian Sea and the southern Adriatic Sea, despite showing relatively high density and abundance values seem to be less relevant to the species. Overall, these findings support the existing evidence that the western basin represents the most important striped dolphin habitat in the region (Mannocci *et al*., 2018b).

II.3.2 Common bottlenose dolphin

Bottlenose dolphins were the second most abundant species (n=64,886; 95% CI=46,337-90,782) observed during the aerial component of the ASI. Mostly observed in coastal areas, confirming existing knowledge on the coast habits and preferences of this species (Bearzi *et al*., 2009), the species distribution appeared strongly fragmented and discontinued with areas of higher abundance found in particular in the Strait of Gibraltar and Alborán Sea, the Balearic Sea and the Gulf of Lion, the waters surrounding the Island of Corsica and north of Tyrrhenian Sea. Bottlenose dolphins appear to be very common in the northern portion of the Adriatic Sea, in the Strait of Sicily and in the Aegean Sea as well. These areas were already considered crucial to the persistence of the species in the Mediterranean (e.g., Forcada *et al*., 2004; Cañadas and Hammond, 2006; de Segura *et al.*, 2006; Gnone *et al*., 2011; Lauriano *et al*., 2014; Laran *et al*., 2017b; Bearzi *et al*., 2021). Therefore, these patches of relatively high density strongly indicate that they contain critical habitats required for the conservation of the species and, given the observed decline of the species during the last few decades, further reiterate the need for basin-wide protection measures.

II.3.3 Common dolphin

The Mediterranean sub-population of common dolphin in the Mediterranean has undergone a drastic reduction in the past decades (e.g., Bearzi *et al*., 2003, 2008; Piroddi *et al.*, 2011; Vella *et al.*, 2021) as a consequence of ever increasing human pressures on the species range of distribution. Habitat loss and fragmentation, alongside the indirect effects of overfishing, unintentional captures during fishing operations and takes have strongly contribute to the decline of dolphins' numbers across the entire region (e.g., Bearzi *et al*., 2003, 2004, 2008; Cañadas and Vázquez, 2017; Mussi *et al*., 2019). Overall, only 32 sightings of common dolphins, mostly encountered in the western portion of the Basin and in the Strait of Sicily, have been recorded during aerial surveys, with a total estimate of 64,940 individuals (95% CI=30,350-138,953), with a marked preference for waters between latitude of 33° and 38° North.

II.3.4 Fin whale

Fin whales in the Mediterranean have been estimated at 2,135 individuals (95% CI=1,241-3,673), confirming that the sub-population of the only mysticete regularly occurring in the Region, despite its overall wide distributional range across the area, constitute a rather small unit. As well as previous estimates (e.g., Forcada *et al.,* 1995) and knowledge (e.g., Notarbartolo di Sciara *et al.,* 2003; Notarbartolo di Sciara, 2016), the ASI monitoring has resulted in the highest abundances in the western and north-western Mediterranean, in particular in the Ligurian Sea, Gulf of Lions and Gulf of Cadiz and with overall density of animals decreasing towards the eastern portion of the Basin. The species distribution shows strong preference for pelagic areas, with several groups detected at depths of 2000 meters or more, reinforcing previous knowledge on the species (e.g., Cotté *et al.,* 2009; Panigada *et al.,* 2017b). While long distance movement within the Mediterranean have been reported (Panigada *et al*., 2017a) these movements primarily occur at the end of the spring season while during the summer the species show a rather limited distributional range in the waters of the Corso-Ligurian-Provençal Basin (Panigada *et al.,* 2006). Aerial surveys for the ASI took part in summer 2018 and corroborate this previous knowledge.

II.3.5 Risso's dolphin

The Risso's dolphin in the Mediterranean is one of the least-known cetacean species in the region and has been the subject of few dedicated studies. The species is known for its strong habitat preferences where dolphins, usually encountered in relatively small groups, favour continental slope sea areas, primarily in the north-western Basin (Bearzi *et al.*, 2011). They are also regularly observed in the Alborán Sea and in the Gulf of Vera, where their range includes deep offshore waters (Cañadas *et al.*, 2002, 2005). In the eastern Mediterranean, most information comes from the Greek seas, where sighting frequencies are usually low and Risso's dolphins are also encountered in mixed-species groups with striped dolphins and short-beaked common dolphins in the deep waters of the semi-closed Gulf of Corinth (Frantzis and Herzing, 2002; Frantzis *et al.*, 2003).

Encounter rates calculated for the ASI support Risso's dolphin preference for the Western part of the Mediterranean Sea, from the Alborán Sea to the south of the Provençal Basin, with high values along the Algerian coast and the Balearic Islands. Nonetheless, Risso's dolphins have been sighted more offshore, in the pelagic environment, than previously reported in the literature. With a total of 58 sightings abundance for this species has been estimated at 24,106 animals (95% CI=13,986-41,548). Highest abundance and density values have been obtained for the Alborán Sea, the Moroccan and Algerian waters and the Balearic Islands. However, the lack of any previous abundance estimates for these areas, in particular the north-western Africa coast, make it difficult to explore any potential changes in the occurrence and distribution of this species in the area. Relatively large groups of Risso's dolphins have also been reported in the Southern Adriatic Sea, the Ionian Sea and the deep Hellenic Trench.

II.3.6 Striped or common dolphin

During multispecies aerial surveys flight altitude and speed are chosen to maximise the probability to detect larger and smaller species alike. Nonetheless, species identification can sometimes be hampered by sea and weather conditions. In the Mediterranean Sea the only two species, often occurring sympatrically, which could be misidentified during aerial surveys, resulting in biased estimates for one or the other species, are common and the striped dolphins. For this reason, during the aerial component of the ASI, a specific species class has been created to be used when a clear distinction between these two species wasn't possible. A total of 148 sightings were made in this class, leading to an overall estimated abundance of 204,035 animals (95 % CI=125,379-332,035). The vast majority of sightings were recorded in the western Mediterranean Sea, in particular in the Alborán Sea and the area of the Strait of Gibraltar, the Balearic Sea, the Gulf of Lion the Ligurian Sea. No sightings were recorded in the northern Adriatic Sea. Predicted abundance for this class clearly reflects the above depicted distribution of the sightings and in part reflects the know overall knowledge on the occurrence of striped and common dolphins in the Region. Future work using the specific composition of species observed during boat surveys (i.e., the ratio of common/striped dolphins in each sighting) could allow to correct abundances for single species, or other unidentified groups.

II.3.7 Sperm, pilot and Cuvier's beaked whales

Sperm and Cuvier's beaked whales are known for their elusive behaviour characterised by long diving times and relatively short surfacing periods (Watwood *et al.*, 2006; Shearer *et al.*, 2019; Quick *et al.*, 2020), making them particularly difficult to spot during aerial surveys (Thomson *et al.*, 2012). To a lesser extent, this also apply to deep-diving pilot whales (Heide-Jørgensen *et al.*, 2002). Accordingly, the abundance ad density estimates derived from aerial surveys could be strongly affected by availability bias and should be considered with care. Overall, sightings of these three species accounted for less than the 2.5 % of all cetaceans' sightings recorded during the ASI, with sperm whales only sighted 10 times, pilot whales 14 times and beaked whales 15 times.

Sperm whales were encountered in both the eastern and western basin, with sightings only recorded within 35° to 40° of latitude North mainly along the Hellenic Trench and in the offshore waters of the Sea of Sardinia. The species abundance has been estimated at 1,416 animals (95% CI=537-3,733).

Long-finned pilot whales were only encountered west of 12° E of longitude confirming the almost exclusive presence of this species in the western Mediterranean Sea (Verborgh *et al.*, 2016), with a strong preference for deep pelagic waters. Largest groups of this species were observed in the Alborán Sea, along the coast of Morocco and in the Gulf Lion. Relatively smaller pods were observed in the Ligurian Sea within the waters of the Pelagos Sanctuary. The species overall abundance is estimated at 5,569 individuals (95% CI= 2,479-12,513).

Cuvier's beaked whales abundance was estimated at 3,009 animals (95% CI=1,404-6,448) from aerial surveys. As expected from existing knowledge, beaked whales have been mostly sighted in areas rich in canyons in the Ionian Sea and the Hellenic Trench, the deep southern Adriatic Sea, the Central Tyrrhenian Sea, the Balearic and the Alborán Seas. The ASI results confirm existing knowledge on the basin wide presence of the species and at the same time confirm how Cuvier's Beaked whales occur in relatively small patches at low densities.

III.VESSEL-BASED SURVEYS CONDUCTED IN 2018/2019

III.1. METHODS

All vessel surveys conducted during the ASI incorporated visual techniques; in addition, passive acoustic techniques were also used where possible, with the areas without aerial survey coverage being considered a high priority. However, visual-only surveys were necessary in those areas where the use of hydrophones was not permitted, such as within the national coastal waters of Lebanon, Egypt and Syria.

Intensive training effort was undertaken to discuss, present and adapt data collection protocols for vessel-based visual surveys. During a one-week training workshop in 2018 in Samos, Greece, researchers from Syria, Lebanon, Libya and Egypt attended training as potential cruise leaders or trainers, in order to be able to conduct independent surveys in their home countries, applying the same shared and standardized protocols. Data logging software, sightings protocols, organisation of watch rotas, as well as acoustic methodology were discussed and adapted to the different needs. The training workshop included two days out at sea to test the survey protocol, distance estimation for each sighting and the data collection software *Logger*. Extensive troubleshooting sessions were dedicated to addressing potential issues during field work and to make sure each participant was confident in solving and handling specific situations.

Following the training workshop, all survey teams used the same protocol for visual surveying. A standardised *Logger* database and set of data entry forms were provided to each vessel participating in the ASI. The R/V *Cana*, belonging to the National Council for Scientific Research (CNRS), was used to survey Lebanese territorial waters up to 12 nautical miles from the coast. Two vessels were selected to survey Egyptian waters; one a general cargo ship and the other supplied by Atlantic Marine Services. A vessel survey was also undertaken in Syrian waters.

III.1.1 Survey design

Vessel-based surveys applying line transect distance sampling methods can provide robust estimates of the abundance and density of a species in a given space and time (Buckland, 2001, 2004) and can be used to detect potential trends (Taylor *et al.*, 2007) and hence inform conservation. Standard line transect methods assume the density of animals on the surveyed transects is equal to the density in the entire study area. This will be true if the transects are placed at random using a design where each part of the study area has an equal probability of being surveyed. Therefore, transects for the vessel surveys were designed as equal spacing zigzags using the specialised software package Distance to provide almost uniform coverage probability. The transects were designed using the same survey blocks designed for the ASI aerial surveys, with minor modifications made due to ongoing discussions with the relevant Government authorities, Focal Points and the ACCOBAMS Secretariat. These transects were designed to provide an acoustic coverage of at least 6% (based on an estimated half strip width of 10 km for sperm whales). A total of 17,272 km of transects were designed for the vessel-based surveys conducted by the Song of the Whale team in the ASI blocks 1 to 15, 22, 25 and 26 (Figure 39). In addition, transects were designed for regional research efforts undertaken in the coastal waters of Egypt (4,571 km in blocks 27 and 28), Lebanon (1,063 km in block 31) and Syria (848 km in block 32).

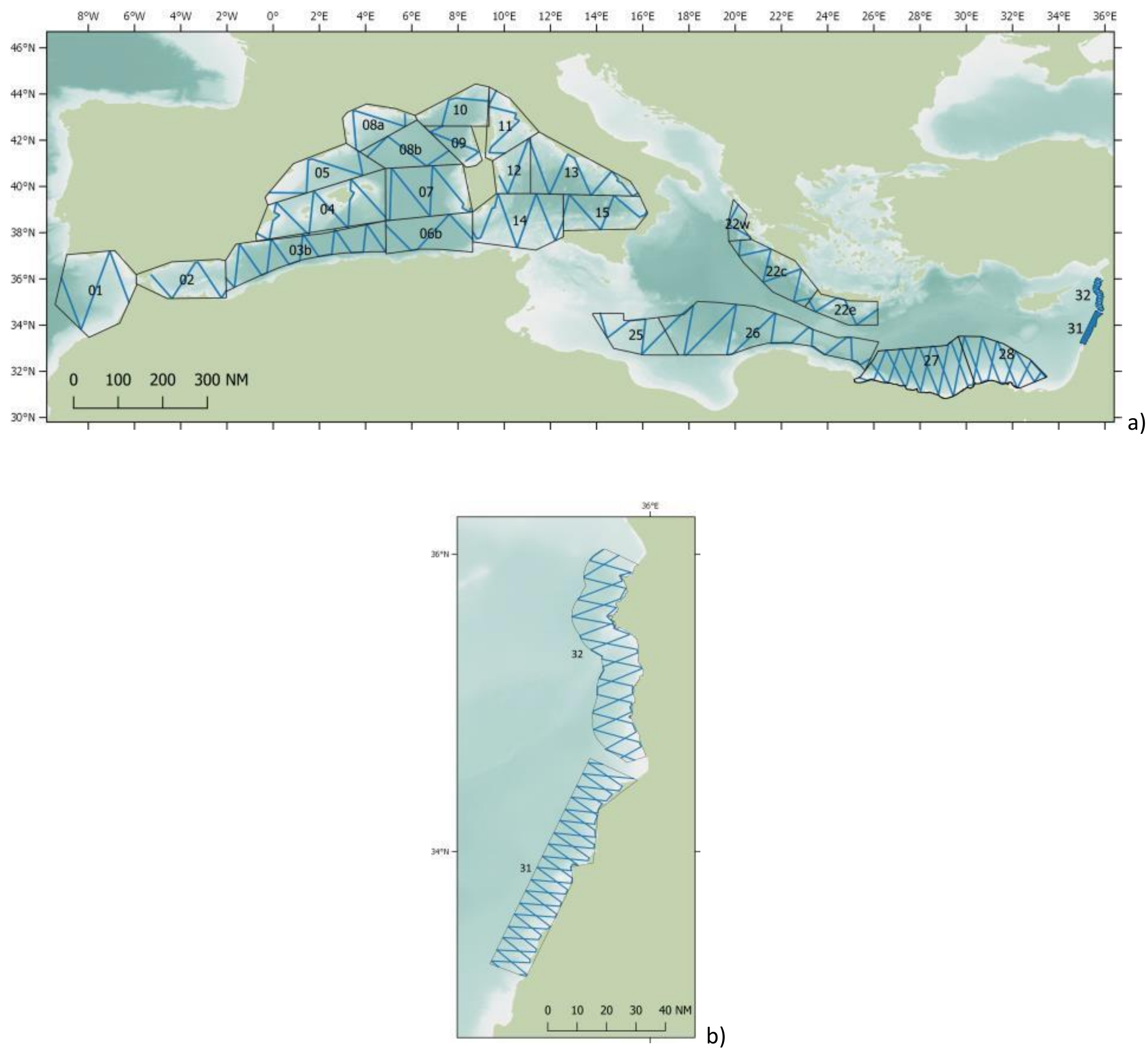


Figure 39. The designed tracks for a) blocks 1-32, b) the designed tracks within 12 nautical miles of land for blocks 31 and 32.

III.1.2 Methodology

III.1.2.1 Visual surveys

All surveys were conducted from vessels capable of spending extended periods offshore with an elevated observation platform providing an eye-height of at least 5 m above sea level. Visual observation effort was separated into two quadrants, with observers primarily scanning the track-line ahead of the vessel. The observer to port (left) scanned the sector from approximately 270° to 20° relative to the ship's bow and the starboard (right) observer scanned the sector from 340° to 90°, namely ahead of the vessel on the port side of the track and ahead of the vessel on the starboard side of the track. Observers scanned their quadrant by naked eye; binoculars (7 x 50 with internal reticule and compass) were used to confirm a sighting, assist with species identity and estimate of numbers. Observers relayed information on species identity, group size, direction of travel (if any) and behaviour to a third team member acting as data logger. The range and bearing to the centre of each group was also estimated. In addition to marine life, visual observers logged sightings of floating debris and fishing activities (set gear and fishing vessels). The vessels were able to break from the survey track during daylight hours to undertake species identification (if required) and to obtain images for photo-identification when appropriate, before returning to the survey track at the point it was left. The specialist Logger software (www.marineconservationresearch.org) was used on all vessels to automatically log the track every 10 seconds from GPS; where possible, the direction of travel from a heading sensor, the wind speed and direction from deck instruments and various other parameters were logged automatically every 10 seconds. Environmental information (including sea state, wave and swell height, cloud cover and glare) were logged manually every hour, or when there was a significant change in conditions. Logger was also used to document the survey effort status at all times, as well as to log sightings of marine life, marine debris, fishing vessels and fishing gear. A standardised Logger database and set of data entry forms were provided to each vessel participating in the ASI.

III.1.2.2 Acoustic surveys

Approximately 75% of the Mediterranean basin was surveyed by aerial teams; however, aerial surveys are known to under-estimate densities of deep-diving species. As an example, the probability of detecting a sperm whale on the track-line (g(0)) has been estimated as being approximately 0.17 from an aircraft with bubble windows flying at 100 knots versus 0.31-0.61 for vessel surveys at approximately 5 knots (Mannocci *et al*., 2018b). The acoustic g(0), however, for a vessel surveying at 5 knots is likely to be more than 0.90 for sperm whales (Fais *et al.*, 2016). Therefore vessel-based acoustic surveys were used to survey areas that are known to be important for sperm whales and beaked whales, as well as to survey those areas for which permission to undertake aerial surveys was not granted. These surveys were conducted from the research vessel Song of the Whale and combined visual surveying and passive acoustic monitoring to enable improved detection of deep- diving species such as sperm whales and beaked whales. The research team aboard R/V Song of the Whale comprised an experienced team leader, several members with previous experience of undertaking marine mammal surveys, and national/regional participants and trainees who were assisted in the field by the more experienced team members. All researchers taking part in the survey received training in visual identification of species, in identifying and logging vocalisations and in distance estimation in the field.

The Song of the Whale survey team conducted acoustic surveys using towed arrays of hydrophones (underwater microphones) capable of detecting all species of cetacean from the infrasonic calls of baleen whales to the ultrasonic clicks of beaked whales. Pairs of hydrophone elements with the appropriate separation allow bearing estimation for the vocalisations of odontocetes. A tow cable of 400 m was used to remove the hydrophone array from any self-noise (e.g., propeller cavitation). Acoustic surveys were conducted 24 hours a day to maximise survey effort when there were appropriate water depths (e.g., more than 50 m deep without submerged obstacles). R/V Song of the Whale maintained survey speeds of 5 to 8 knots; a minimum speed of 5 knots is required to stream an array and a maximum of 8 knots to reduce cable strum. Survey vessels should travel at least two or three times faster than the average speed of the animals being surveyed in order to avoid biases related to animal movement. For most species, this was the case; for example, the mean speed of sperm whales has been reported as 2.1 to 2.5 knots. Although vessel speed is less critical between transects, the zigzag design in Figure 39 minimised the amount of time spent off effort.

III.1.3 Data analysis

III.1.3.1 Acoustic surveys

Recordings made in the field were examined in Pamguard, a passive acoustic monitoring software package (Gillespie *et al.,* 2009b). Individual click trains from all species (sperm whales, beaked whales and small odontocetes) were identified and the analysis of the first observer was subsequently validated by a second experienced acoustic observer. Estimates of perpendicular distance from the track-line were made using target motion analysis. The perpendicular distances to only those detections made on transect were used for subsequent distance sampling. During distance sampling a number of covariates collected in the field were also included to refine the acoustic detection function. Density estimates were subsequently generated.

III.1.3.1.1 Identification of individual click trains

The binary storage files collected in the field using *Pamguard* were analysed by an experienced acoustic observer for evidence of odontocete clicks. Additional cross referencing was made to any reports of odontocete clicks made during the regular listening stations made in the field (whereby the hydrophone array was monitored for two minutes every 15 minutes).

Sperm whales produce loud broadband clicks (up to 236 dB re 1µPa (rms)) during regular deep foraging dives with typical inter-click intervals of 0.3–8s (Møhl *et al.,* 2003). As inter-click intervals typically vary gradually with only occasional short gaps (Wahlberg, 2002) individual animals can be tracked during the course of a dive. Sperm whales click trains were this identified by their stereotypical spectral properties (with most energy at or below 12 kHz), waveforms (with rapid onset and offset and evidence of multiple pulses within each click) and inter- click intervals (a regular click being produced every 1-2 seconds). Typical beaked whale clicks have the distinctive form of a relatively long duration (~200 µs) FM upsweep with dominant energy between 25 and 50 kHz (Johnson *et al.*, 2004; Gillespie *et al.*, 2009a). Thus, sounds with significant energy (>6 dB above background noise) in the 25 to 50 kHz band can be classified as potential beaked whale clicks in a click detector module in Pamguard. Candidate beaked whale clicks were selected if they had significant energy in the 25 to 50 kHz energy band, had a waveform resembling that of published data for other beaked whale species, had an upswept narrowband structure revealed in a Wigner plot and formed part of a click train, i.e., with similar bearings and regular inter-click intervals. For those echolocation clicks that could not be identified as either sperm whale or beaked whale, it was assumed they were produced by a small odontocete. This could typically be corroborated by the detection of whistles, either aurally or on a spectrogram.

Differences in bearing information were used to identify individual odontocete click trains (Figure 40). Thus, acoustic detections could be made at the individual level, rather than the group level. For subsequent distance estimation, those periods in the click train with the fastest change in bearing information (i.e., when a vocalising sperm whale passed from in front to behind of the hydrophone array) were most useful for localisation.

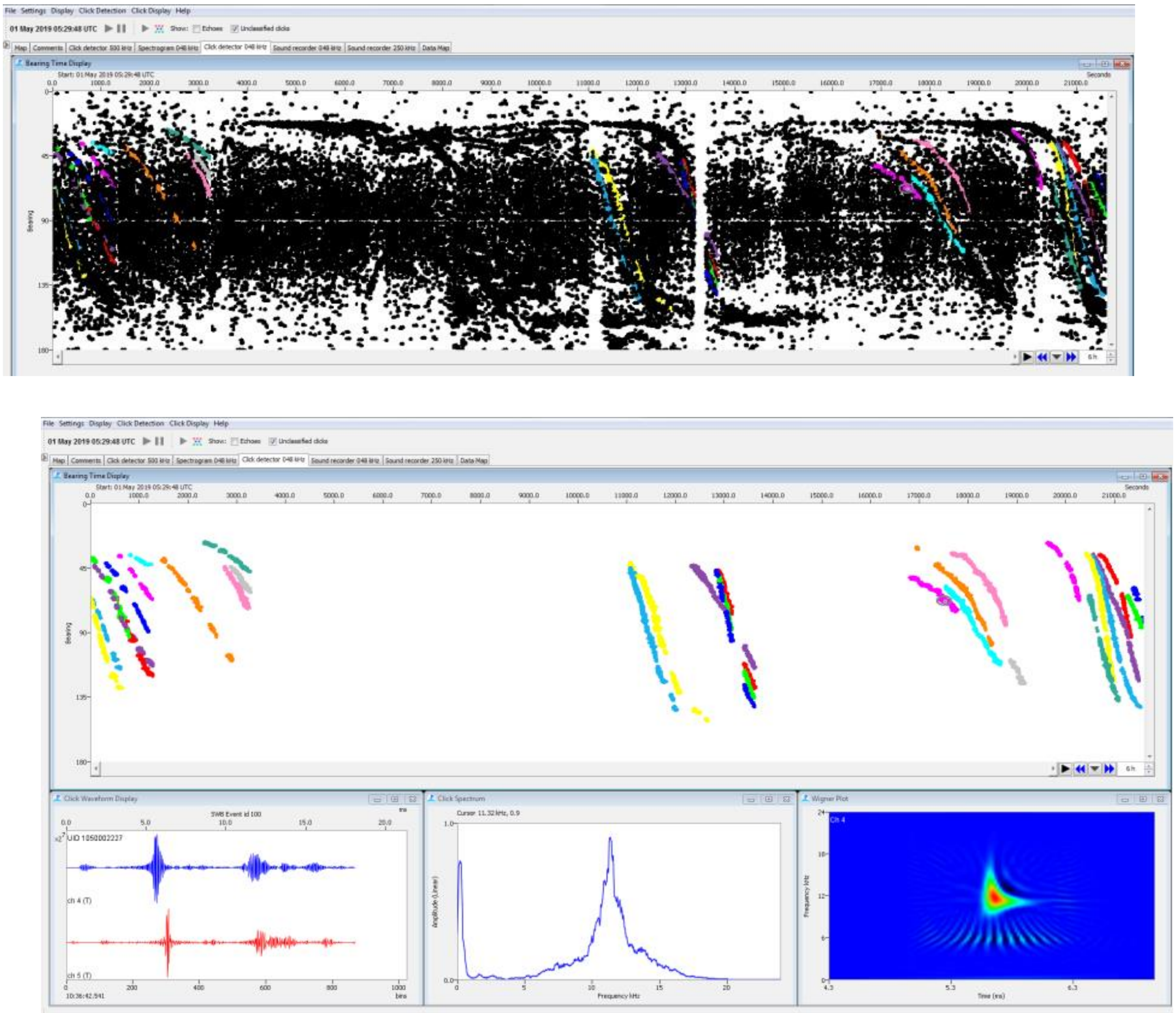


Figure 40. Example of a -six-hour period of acoustic effort analysed in Pamguard. The upper window shows relative bearing information on the y-axis (0-180°) plotted against time (six hours) on the x- axis. Black ovals represent click type events. In the first display (above), individual sperm whale click trains have been manually marked up with different colours. Subsequent removal of extraneous false triggers (middle), clarifies the bearing information for individual click trains. The lower windows (c) display the characteristic waveform (left), spectrum (centre) and Wigner plot (right) characteristic of sperm whale clicks.

III.1.3.1.2 Localisation of individual click trains

Localisation of vocalising odontocetes was conducted in *Pamguard* using target motion analysis. A towed hydrophone array will detect a series of different clicks from a focal animal as it moves through the water. The path of the array along the track-line can be estimated by the offset GPS log of *Song of the Whale*. If the source is assumed to be stationary then each detected click corresponds to a set of time delays at some position along the track-line. Each set of time delays can be visualised as a 2D bearing pointing towards the acoustic source. As more clicks are detected more bearings are calculated along the track-line and eventually they should begin to cross around the likely location of the source (Figure 41).

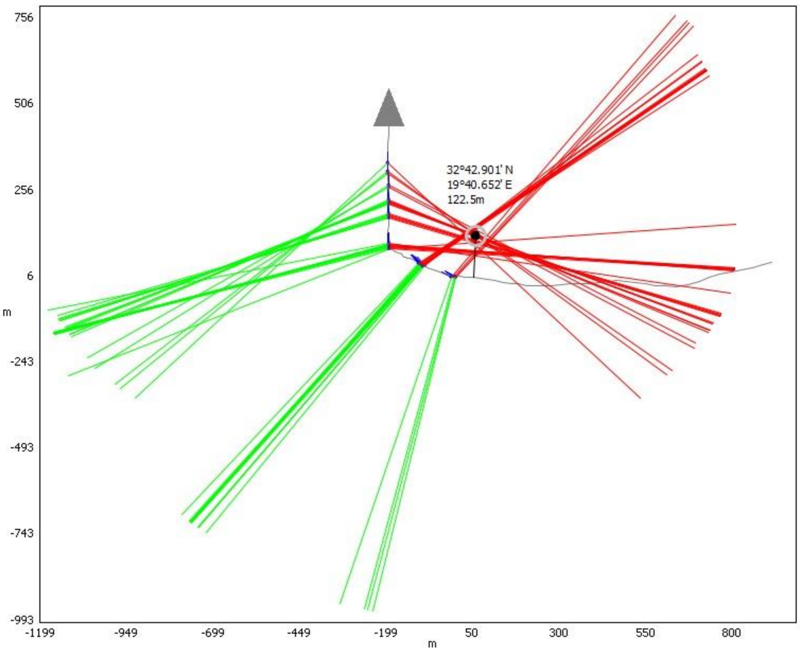


Figure 41. Estimating perpendicular distances in *Pamguard* using target motion analysis. The vessel's track is shown as the grey line, with bearing lines for consecutive sperm whale clicks projected to either side of the vessel. *Pamguard* uses incremental changes in the vessel's heading to resolve left/right ambiguity. In this example, the 2D position of the vocalising whale is 122 m to starboard of the hydrophone array's beam.

III.1.3.1.3 Environmental covariates affecting sperm whale detection function

During the ASI survey, several environmental parameters were logged automatically or estimated by observers. Some of these were used as covariates in subsequent detection function estimation for sperm whales, as that could affect the acoustic detection range of the hydrophone array; vessel heading (0-360°), vessel speed (0-10 knots), engine revs (0-2600 rpm), wind speed (0-32 knots), wind direction (0- 360°), sea surface temperature (12-26°C), sea state (0-6), wave height (m), swell height (m) and rain condition (heavy, light or none). It was assumed these covariates could affect the rate at which detectability decreased with distance, but not the overall shape of the detection curve.

Prior to including covariates in subsequent analysis, they were first investigated for correlation using Pearson's correlation to remove any potential redundancy. As might be expected, the covariates wind speed and wave height were found to be strongly correlated ($r = 0.566$, $p<0.001$); as wind speed was logged by a sensor on board R/V *Song of the Whale*, it was used in lieu of the subjective estimates of wave height.

Distances estimated in Pamguard were subsequently imported into the Distance software to generate acoustic detection functions and density/abundance estimates using multiple covariates distance sampling (MCDS). Only detections made whilst on transect and following the survey protocol (i.e., 5-8 knots) were used.

III.1.3.2 Visual surveys

As with the aerial surveys, detection functions were generated using all sightings of identified species made during the vessel surveys. However, the lower coverage provided by the vessel surveys could result in low sample sizes for several species, which could prevent the estimation of robust detection functions. Thus, composite detection functions were also generated using sightings made from Song of the Whale's primary observation platform (typical eye height = 5.4 m above sea level) on previous line-transect surveys between 2004 and 2018. Only those sightings made from the same observation platform and using the same research protocols were collated; sightings were thus made by observers with the same average eye-height with the same degree of environmental clutter (e.g., rigging) as for R/V Song of the Whale's ASI surveys. For some of the species encountered in the ASI survey, there were too few sightings (<60) in the collated dataset to generate a robust detection function. In this case, sightings of species with similar physical characteristics and behaviours were pooled to generate more meaningful detection functions. To ensure consistency with the aerial surveys, the density estimates generated using the ASI-only detection functions are presented, along with those generated using the pooled datasets.

During the ASI survey, several environmental parameters were logged automatically or estimated by observers. As for acoustic detections, some of these were used as covariates to refine subsequent detection function estimation. The covariates used were year, local time of day, cluster size, sea state (0-6), wave height (m), swell height (m), cloud cover (0-10) and visibility (0-3). It was assumed these covariates could affect the rate at which detectability decreased with distance, but not the overall shape of the detection curve. Prior to including covariates in subsequent analysis, they were first investigated for correlation using Spearman's rank-order correlation in SPSS to remove any potential redundancy.

These covariates were then used in a MCDS framework to generate visual detection functions. Only sightings made whilst on transect and following the survey protocol (i.e., 5-8 knots) were used. Subsequent estimations of density were corrected for availability bias generated using the Song of the Whale datasets from 2003 to 2018 (Cañadas and Vázquez, 2014; Mannocci *et al*., 2018a).

III.2. RESULTS

Although the initial intention was for all vessel surveys to be conducted concurrently with the aerial surveys, this was only realised for the *Song of the Whale* transects due to security and logistical considerations in Egypt, Lebanon and Syria.

Table 16. A summary of survey effort in each of the ASI blocks surveyed by vessel. Designed effort is the total length of the transects generated using Distance; the effective effort achieved in the field refers to navigation following pre-determined transects with visual effort (and/or acoustic effort for Song of the Whale). Numbers in parentheses represent the percentage of transects that were completed with appropriate research effort. Incidental effort incorporated those periods with visual and/or acoustic effort outside survey transects. Total effort incorporates those periods with neither acoustic nor visual effort, in addition to periods on track or with incidental effort. The survey coverage realised by the Song of the Whale team is expressed as 'acoustic coverage' and is based on an effective strip (half) width of 10 km for sperm whales; the survey coverage realised by the other teams (*) is expressed as 'visual coverage' and is based on an effective strip (half) width of 500 m for most species.

Block	Designed effort (km)	Effective effort (km)	Incidental effort (km)	Total effort (km)	Survey coverage	Start date	End date
Block 1	936	872 (93 %)	214	1,143	0.186	28/05/18	01/06/18
Block 2	722	515 (71 %)	709	1,301	0.213	01/06/18	11/06/18

Block 3	1,572	1,520 (97 %)	256	1,812	0.342	11/06/18	28/09/18
Block 4	1,422	1,057 (74%)	449	2,008	0.229	15/06/18	29/09/18
Block 5	791	559 (71 %)	365	995	0.206	03/07/18	10/07/18
Block 6	567	465 (82 %)	432	912	0.170	20/06/18	28/09/18
Block 7	1,155	994 (86 %)	90	1,092	0.272	24/06/18	28/06/18
Block 8a	528	330 (62 %)	83	527	0.191	10/07/18	12/07/18
Block 8b	507	381 (75 %)	98	546	0.163	12/07/18	14/07/18
Block 9	427	291 (68 %)	81	372	0.265	14/07/18	16/07/18
Block 10	335	247 (74 %)	24	357	0.145	16/07/18	21/07/18
Block 11	620	324 (52 %)	63	497	0.206	21/07/18	22/07/18
Block 12	445	381 (86 %)	134	515	0.279	22/07/18	24/07/18
Block 13	1,109	839 (76 %)	130	978	0.251	24/07/18	28/07/18
Block 14	1,214	958 (79 %)	301	1,894	0.243	21/06/18	27/09/18
Block 15	742	622 (84 %)	133	815	0.258	28/07/18	01/08/18
Block 22west	233	209 (90 %)	55	264	0.390	14/08/18	18/08/18
Block 22centre	845	763 (90 %)	695	1,458	0.317	18/08/18	06/09/18
Block 22east	443	363 (82 %)	226	589	0.262	21/08/18	06/09/18
Block 25	665	646 (97 %)	4	761	0.290	07/09/18	23/09/18
Block 26	1,888	1,707 (90 %)	492	2,302	0.251	07/09/18	16/09/18
Block 27	2,605	1,122 (43 %)	1,232	2,354	0.015*	15/10/19	03/11/19
Block 28	1,892	978 (52 %)	684	1,662	0.018*	15/10/19	01/11/19
Block 31	852	634 (74 %)	276	911	0.159*	08/08/18	11/09/18
Block 32	671	431 (64 %)	453	884	0.110*	27/07/19	08/08/19
Total track (*Song of the Whale*)	17,167	14,043 (82 %)	5,034	21,138	0.244	28/05/18	29/09/18
Total track (all	23,187	17,208 (74 %)	7,679	26,949	0.217	28/05/18	03/11/19

III.2.1 Sightings from R/V Song of the Whale

Between 28th May and 29th September 2018, the Song of the Whale team completed almost 22,000 km of survey effort as part of the ACCOBAMS Survey Initiative, in both the eastern and western basins (Figure 42; Table 16). Of this effort, approximately 14,449 km (66 %) was "on track", i.e., following pre-determined survey transects with 24-hour acoustic effort (and visual effort during daylight hours when weather conditions were appropriate).

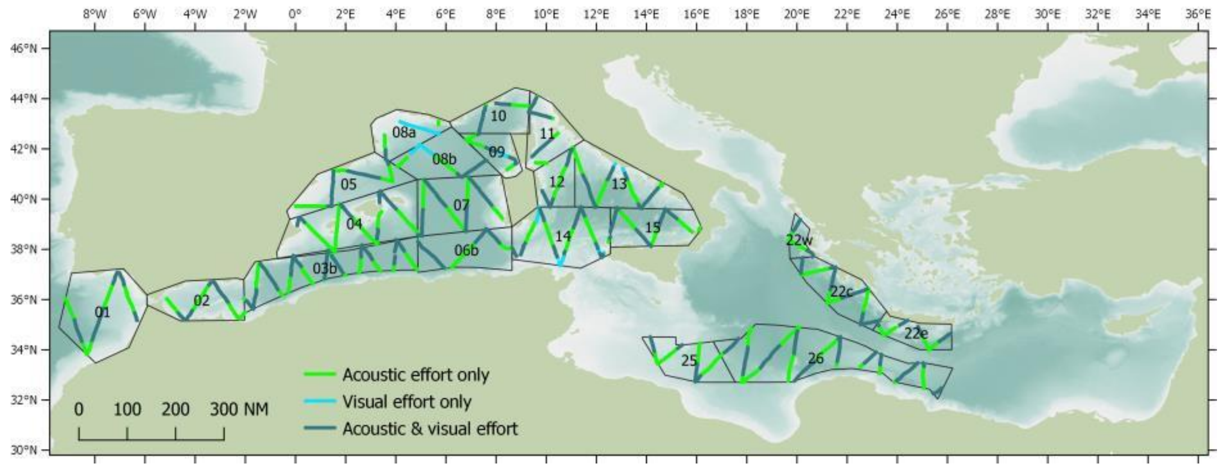


Figure 42. Survey transects completed by the *Song of the Whale* team between 28th May and 29th September 2018.

Over 80 % of the designed transects were completed; segments of some transects could not be completed for several reasons, including lack of suitable depth for the vessel and/or towed hydrophone array, the need to bypass islands/reefs and permit constraints. Globally, an acoustic coverage of 24 % was realised, based on an effective strip (half) width of 10 km derived previously for acoustic detections of sperm whales from R/V Song of the Whale using acoustic techniques (Table 16).

During the visual surveys, nine species of cetacean were identified (Table 17); these included fin whale and sperm whale (Figure 43), Cuvier's beaked whale, long-finned pilot whale, Risso's dolphin and rough-toothed dolphin (Figure 44), and common bottlenose dolphin, common dolphin and striped dolphin (Figure 45). Most sightings of cetaceans were made between the Straits of Gibraltar and Corsica/Sardinia (Table 18).

Fin whales were encountered during the R/V *Song of the Whale* surveys within the typical range known for this species, i.e. Balearic Sea, Gulf of Lion and Ligurian Sea (Mannocci *et al.*, 2018b); Figure 3). Sperm whales and Cuvier's beaked whales are discussed in more detail in the section below summarising acoustic detections.

Long-finned pilot whales were only encountered in the western basin, where previous studies have led to this species being considered common (Figure 44). Similarly, Risso's dolphins were only encountered in the western basin, although previous studies have suggested this species is typically found where its preferred habitat occurs, including in the eastern basin. Although rough-toothed dolphins were only encountered once by the *Song of the Whale* team, this sighting was made in Greek waters, and supports the tentative proposal that this species should be considered as regular in the eastern Mediterranean Sea (Kerem *et al.*, 2016), retaining visitor status in the western basin (Notarbartolo di Sciara & Birkun, 2010). This species had only been previously observed once in Greek waters, halfway between Greece and Italy in the Ionian Sea (Boisseau *et al.*, 2010). The first sighting was made in 2003, from R/V *Song of the Whale*, just 140 km west of the ASI sighting in 2018.

Bottlenose dolphins were seen in scattered and fragmented groups, as usually reported for this species in the Mediterranean; they were encountered in their typical habitat, namely inshore and coastal waters (Figure 45). Common dolphins were also encountered throughout their known range, although sightings around Sicily and the southern Tyrrhenian Sea are of particular importance as this area is considered data deficient for this species. Striped dolphins were reported throughout both the western and eastern basins in agreement with its description as the most common and ubiquitous cetacean in the Mediterranean Sea.

In addition, several non-mammalian vertebrate species were encountered, including fish species (Figure 46) and turtles (Figure 47). Sightings of marine debris were also logged during the surveys (Figure 48); of the 2,489 items seen, over 86 % were plastic (Table 19).

Table 17. A summary of all sightings made during the ASI from R/V *Song of the Whale*. * summary figures for cetaceans only.

Clade	Number of sightings	Mean group size	Min. group size	Max. group size
CETACEA				
Bottlenose dolphin	25	5.4	1	25
Common dolphin	29	10.5	1	70
Cuvier's beaked whale	2	1.3	1	2
Fin whale	24	1.8	1	12
Long-finned pilot whale	6	10.4	2	30
Risso's dolphin	7	4.4	1	12
Rough-toothed dolphin	1	6.0	6	6
Sperm whale	26	1.7	1	7
Striped dolphin	130	10.4	1	100
Unidentified dolphin	73	5.9	1	100
Unidentified whale	8	1.1	1	2
FISH				
Jumping fish	100	20.4	1	1000
Sunfish	17	1.1	1	2
Unidentified shark	4	1.0	1	1
Other species	7	2.8	1	20
TURTLES				
Loggerhead turtle	96	1.1	1	3
Unidentified turtle	37	1.2	1	6
UNKNOWN	25	1.2	1	4
Total*	332	7.3	1	100

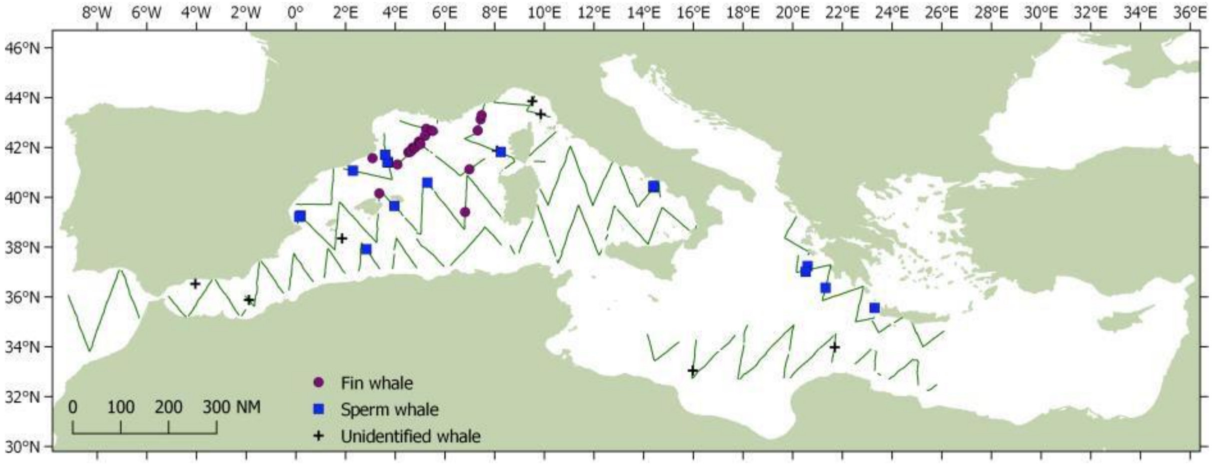


Figure 43. Sightings of all large cetacean species made from R/V *Song of the Whale*.

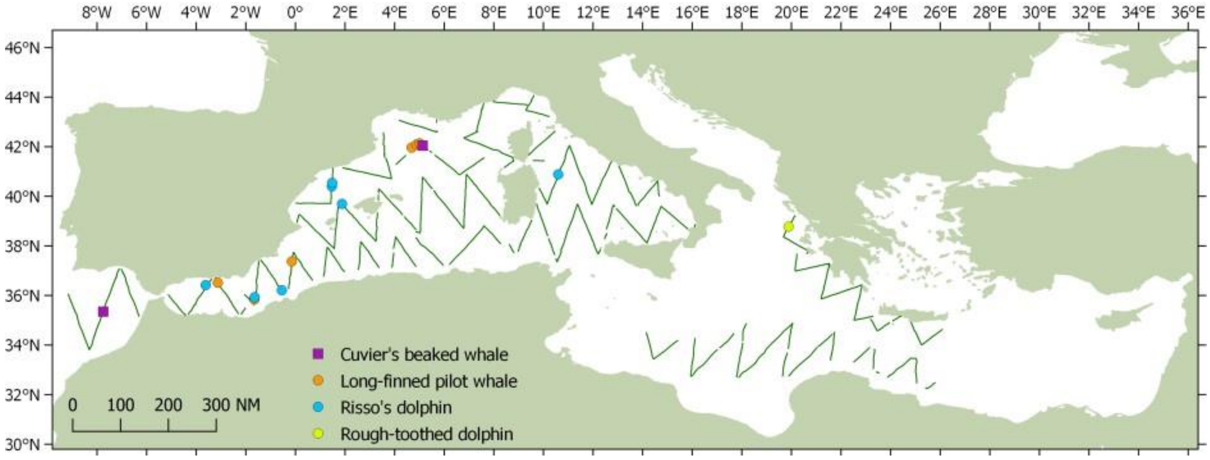


Figure 44. Sightings of all medium cetacean species made from R/V *Song of the Whale*.

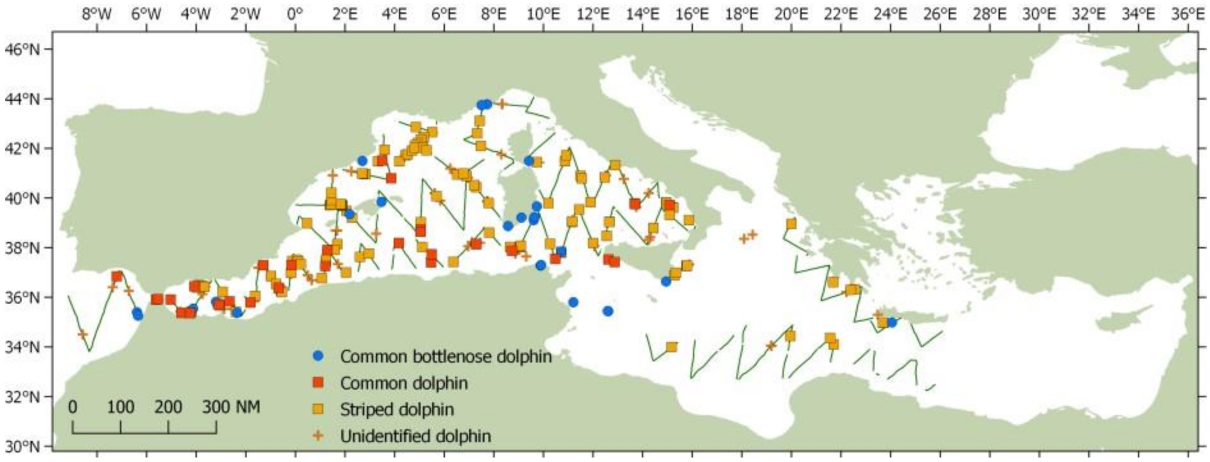


Figure 45. Sightings of all small cetacean species made from R/V *Song of the Whale*.

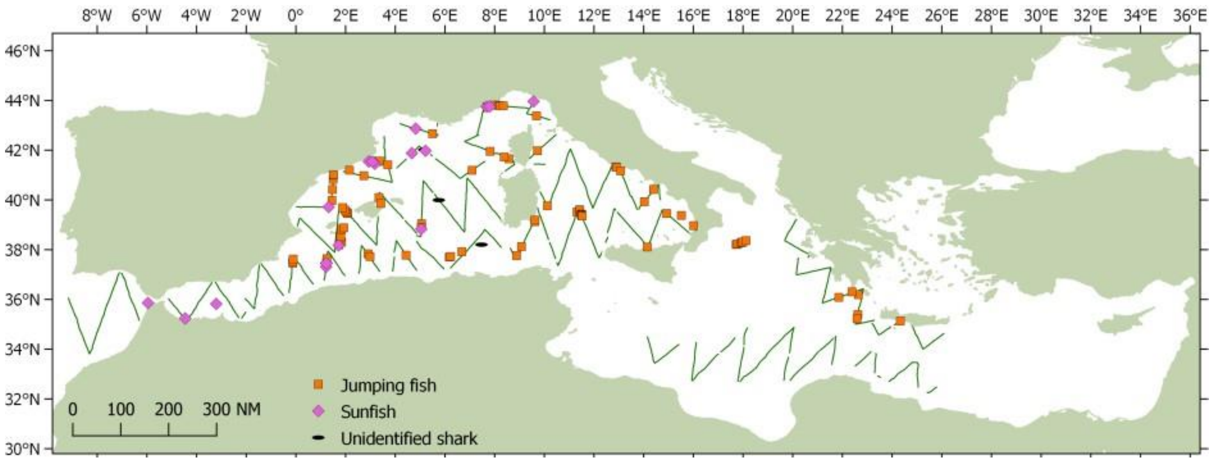


Figure 46. Sightings of all fish made from R/V *Song of the Whale*.

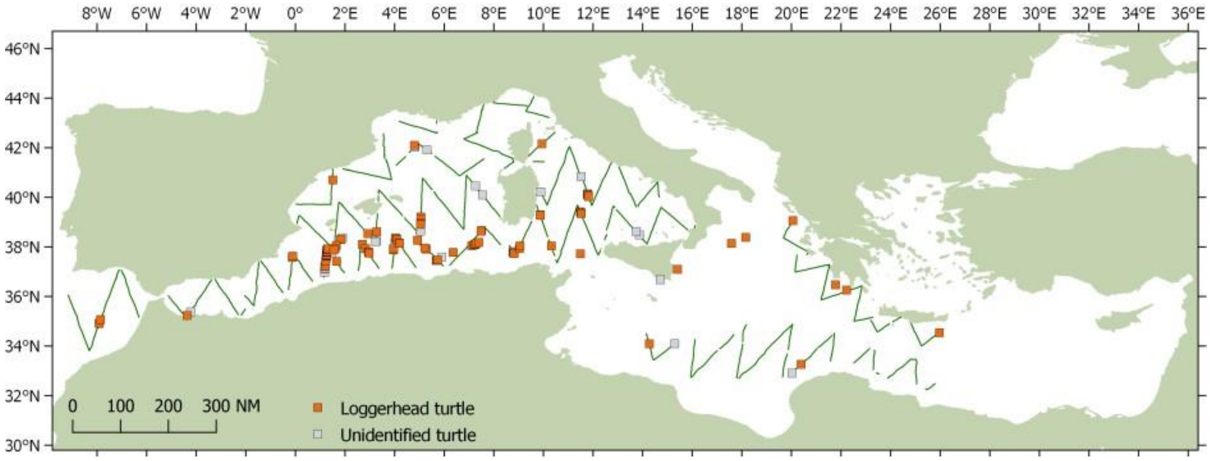


Figure 47. Sightings of all turtle species made from R/V *Song of the Whale*.

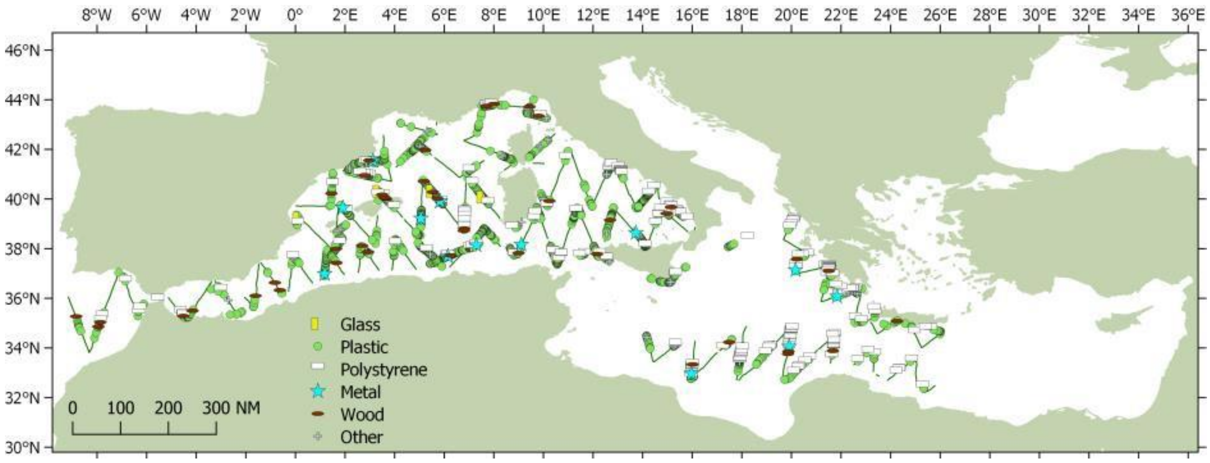


Figure 48. Sightings of marine debris made from R/V *Song of the Whale.*

Table 18. Cetacean species seen “on track” (i.e., following transects with visual effort during daylight with appropriate weather conditions).

	Bottlenose dolphin		**Common dolphin**		**Cuvier's beaked whale**		**Fin whale**		**Long-finned pilot whale**		**Risso's dolphin**		**Rough-toothed dolphin**		**Sperm whale**		**Striped dolphin**		**Unidentified dolphin**		**Unidentified whale**		
Block	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off	
1	2		1		1														3				7
2	1	3	2	6					1			1					1	9	3	3		1	31
3			6	1					2		1	1			1		13	6	9	1	1		42
4	1	1					1				1				3	1	8	4	4	3		1	28
5		1		2				1			2				2	7	8	1	6				30
6		1	1	2													3	1	2	2			12
7			2				1								1		7		6				17
8a							3	3							2		3	4					15
8b					1		9	3	2	1							6	3	3	2			30
9															1		2		1		1		5
10		2					3										1		2				8
11		1															1		1		2		5
12												1					3						4
13			1	1												4	6	7	4				23
14	4	3	2														10	1	4	2			27
15																	4	2	2				7
18																		6		3			9
20		1		2																1			6
21		3																		1			3
22w													1				1						2
22c																4	1	2	1	1			9
22e		1																2		1			4
25																		1			1		2
26																	2	1	2		1		6
Total	8	17	15	14	2	0	17	7	5	1	4	3	1	0	10	16	82	48	53	20	6	2	332

Table 19. Count of the different categories of marine debris seen in each survey block from R/V *Song of the Whale*.

Block	**Plastic**	**Polystyrene**	**Wood**	**Metal**	**Glass**	**Other**	**Total**
1	26	5	3	-	-	1	35
2	39	6	2	-	-	1	48
3	124	2	6	1	-	2	135
4	132	6	6	1	2	5	152
5	138	7	3	1	-	8	157
6	272	7	1	2	1	2	285
7	260	10	5	3	2	7	287
8a	26	-	-	-	-	1	27
8b	68	1	2	-	-	2	73
9	34	-	-	-	-	1	35
10	53	4	2	-	-	-	59
11	62	1	2	-	-	5	70
12	22	2	1	-	-	1	26
13	147	17	1	-	-	4	169
14	226	15	2	1	1	9	254
15	136	14	2	1	-	5	158
22w	15	8	-	-	-	1	24
22c	74	31	2	2	-	5	114
22e	25	3	1	-	-	-	29
25	92	8	1	2	-	7	110
26	176	51	4	1	-	10	242
Total	2147	198	46	15	6	77	2489

III.2.2 Sightings from Lebanon

The Lebanese research vessel *Cana* was used in August 2018 to survey the territorial waters of Lebanon (block 31), with two sets of transects running perpendicular to the coastline. The survey effort started on August 8th and ended on 11th September and comprised 634 km of on-transect effort. The transects were truncated a few nautical miles from the Syrian and Israeli borders. The transects of the R/V *Cana* are shown in Figure 49. Only one cetacean species was encountered, the common bottlenose dolphin (Table 20).

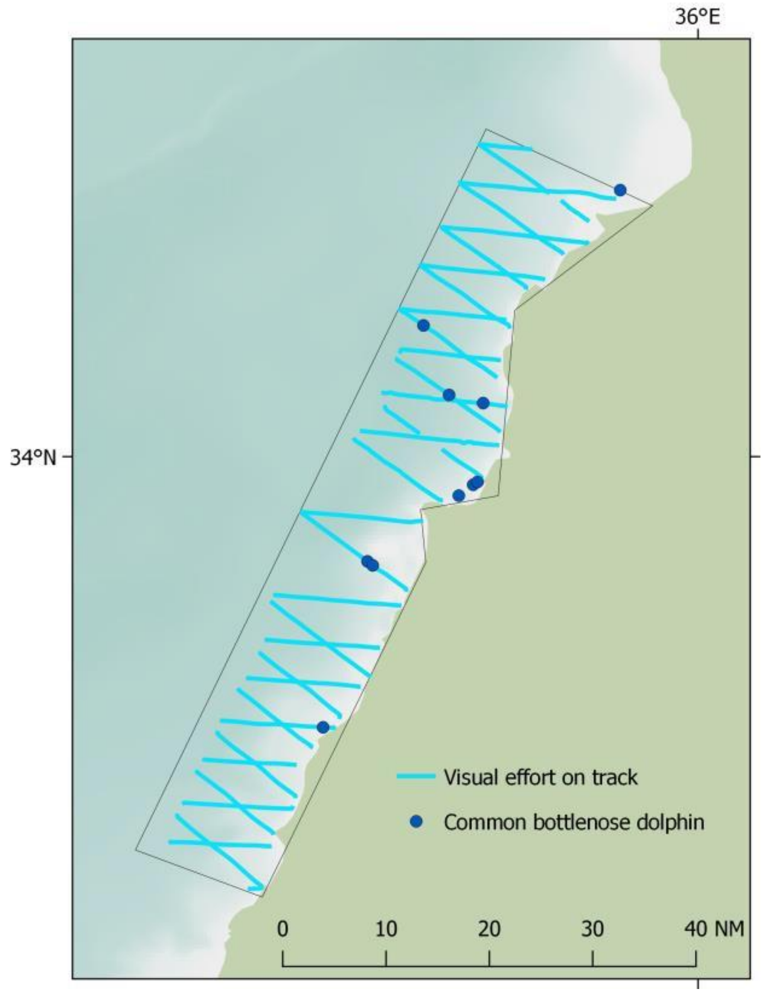


Figure 49. The tracks of the R/V *Cana* along the Lebanese coast with all sightings shown.

Table 20. A summary of all cetacean sightings made during the ASI from R/V *Cana* in Lebanese waters.

Species	**Number of sightings**	**Mean group size**	**Min. group size**	**Max. group size**
Bottlenose dolphin	10	1.4	1	4

III.2.3 Sightings from Egypt

A two-day training program was held in Rashid City from 11-12 October 2019, with the 24 main and alternate team members present. This was followed by practical training using the boats in block 27 between the 13th and 15th October with most team members and team leaders from each boat. Surveys of blocks 27 and 28 then began on 15th October and ended on 3rd November (block 27) and 1st November (block 28). In block 27, the team completed all of the primary transects (1,122 km of on-track effort; 43 % of the total designed); in block 28, the team completed 52 % of the primary and secondary tracks (978 km of on-track effort; Figure 50). Although eight cetacean species were encountered across both blocks, only some sightings of bottlenose, common, rough-toothed, striped dolphins and Cuvier's beaked whale were logged as 'definite', with all other sightings logged as 'probable' or 'possible' (Table 21). The definite sighting of rough-toothed dolphin is the first confirmed for Egyptian waters and is noteworthy as it provides more evidence that the eastern basin represents the only region in the Mediterranean used continuously by this species (Boisseau *et al.*, 2010; Ryan *et al.*, 2014; Kerem *et al.*, 2016).

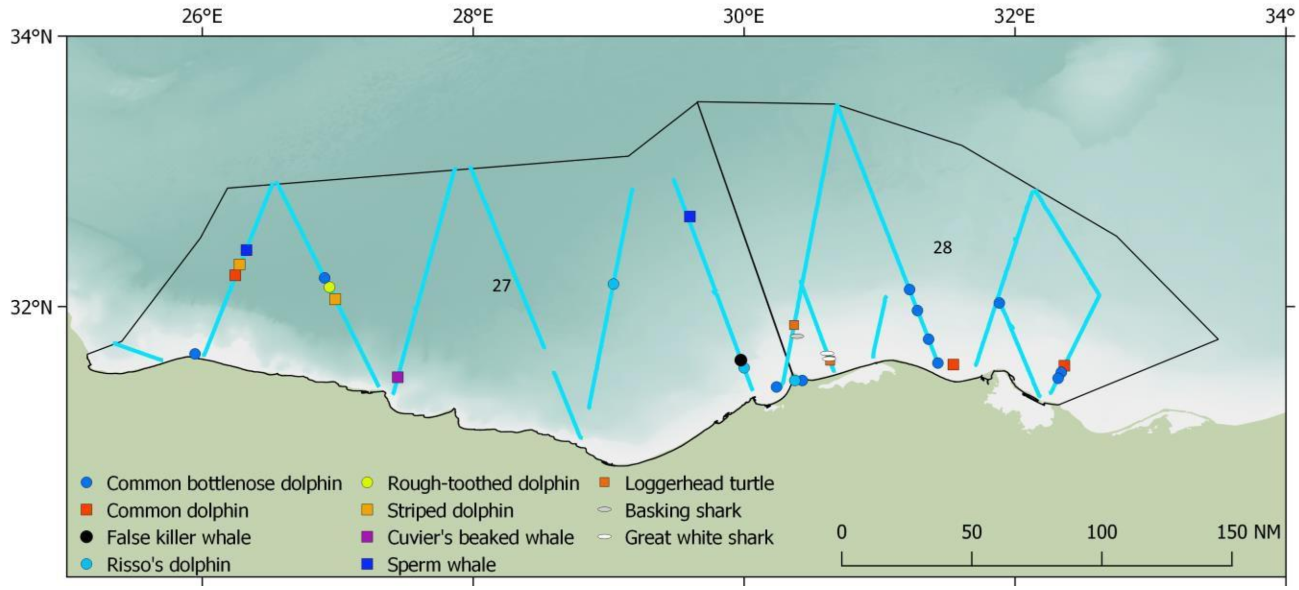


Figure 50. Visual effort on track for both vessels in Egyptian waters with sightings shown

Table 21. A summary of all cetacean sightings made during the ASI in Egyptian waters. Only five sightings (of bottlenose, common, rough-toothed and striped dolphins and Cuvier's beaked whale) in block 27 had a confidence level of 'definite'; all sightings in block 28 had a confidence level of 'definite'.

Block	Species	Number of sightings	Mean group size	Min. group size	Max. group size
27	Bottlenose dolphin	4	4.8	1	10
	Cuvier's beaked whale	1	2.0	2	2
	Common dolphin	1	5.0	4	5
	Risso's dolphin	3	4.7	1	10
	Rough-toothed dolphin	1	6.0	4	6
	Striped dolphin	2	4.5	4	5
	False killer whale	1	2.0	1	2
	Sperm whale	2	3.5	2	5

28	Bottlenose dolphin	7	5.7	2	20
	Common dolphin	2	3.0	2	4
	Loggerhead turtle	2	1.0	1	1
	Basking shark	1	1.0	1	1
	Great white shark	2	1.0	1	1

III.2.4 Sightings from Syria

The Syrian vessel *Okeanos* was used in August 2019 to survey the territorial waters of Syria (block 32), with two sets of tracks perpendicular to the coastline (Figure 51). Survey effort started on 27th July and ended on 8th August and comprised 431 km of on-track effort. The tracks were truncated a few nautical miles from the Lebanese and Turkish borders. Although five cetacean species were encountered, the confidence of all but one of these sightings was logged as 'probable' or 'possible', with only encounter with striped dolphins being logged as 'definite' (Table 22).

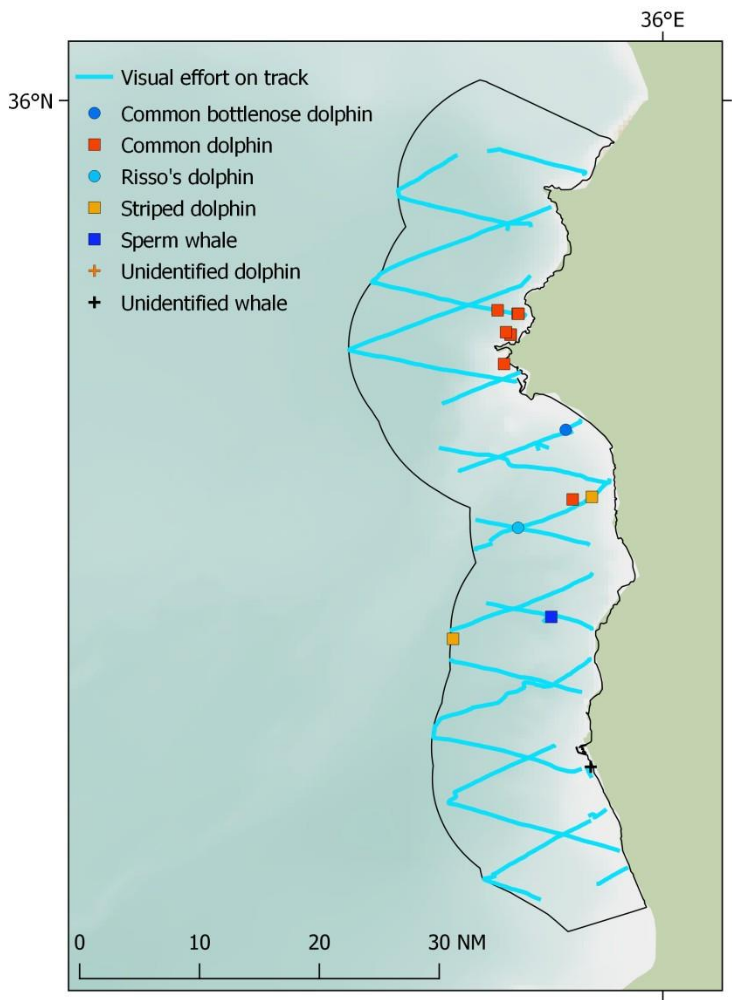


Figure 51. The tracks of the *Okeanos* along the Syrian coast with all sightings shown.

Table 22. A summary of all cetacean sightings made during the ASI from Okeanos in Syrian waters. Only one sighting (striped dolphins) had a confidence level of 'definite'.

Species	**Number of sightings**	**Mean group size**	**Min. group size**	**Max. group size**
Bottlenose dolphin	1	1.0	1	1
Common dolphin	8	2.8	1	5
Risso's dolphin	1	2.0	1	2
Striped dolphin	2	1.0	1	1
Sperm whale	1	1.0	1	1
Unidentified whale	1	2.0	1	2

III.2.5 Visual density estimation

III.2.5.1 Sightings from R/V Song of the Whale

Due to low sample sizes for several of these species seen during the surveys, composite detection functions were generated using previous datasets collected from R/V *Song of the Whale*. A total of 2,857 sightings of 34 species had been made since the *Song of the Whale* team started using consistent visual protocols in 2003 (Table 23). In addition to these enhanced analyses, an additional analysis was conducted using only those sightings made in 2018 during the ASI surveys. This allows an assessment of the feasibility of a basin- wide survey conducted every few years without any prior data collection.

Table 23. Summary of detection functions generated using Song of the Whale surveys. For those species with too few sightings (<60) in the collated 2003-2018 dataset, sightings of other similar species were pooled to improve the robustness of detection functions.

Species	**# sightings**	**# sightings on track**	**# sightings off track**	**# sightings in pooled function**
Striped dolphin	130	82	48	399
Common dolphin	29	15	14	616
Bottlenose dolphin	25	8	17	210
Risso's dolphin	7	4	3	49
Fin whale	24	17	7	144

The probability of detecting an animal on the track-line, g(0), is affected by both availability bias (i.e. observers not seeing animals when they are submerged) and perception bias (observers not seeing animals when they are at the surface). If g(0) is assumed to be 1, subsequent densities and abundances may be underestimated, as detectability is typically less than unity. Although correcting for perception bias, availability bias was corrected for by using published dive durations and surfacing times from the Mediterranean Sea, where available. The following equation from (Laake *et al.*, 1997) was used to derive a g(0) estimate for each species following (Cañadas and Vázquez, 2014):

$$\text{Availability bias} = \frac{E_s}{E_s + E_d} + \frac{E_d\left(1 - e^{\left(\frac{-E_d r}{v}\right)}\right)}{E_s + E_d}$$

where Es was the mean time in seconds spent at the surface, Ed was the mean dive duration in seconds, r was the maximum expected detection distance in metres (taken as the 90th percentile of radial distances as in (Cañadas and Vázquez, 2014) and v was the mean vessel speed in metres per second. Species-specific estimates of g(0) are presented in (Table 24)

Table 24. Species-specific estimates of g(0) used to correct density and abundance estimates for availability bias. These estimates were derived by applying the formula of (Laake *et al.*, 1997) following (Cañadas and Vázquez, 2014) with the dive parameters from the listed sources.

Species	***g*(0)**	***r* (m)**	***v* (m/s)**	***Ed* (s)**	***Es* (s)**	**Source for *Ed* and *Es***
Striped dolphin	1.00	1820	3.2	66	133	Gomez de Segura *et al*., 2006
Common dolphin	0.98	560	3.1	66	133	As for striped dolphin
Bottlenose dolphin	0.99	780	3.1	69	231	Forcada *et al*., 2004
Risso's dolphin	0.77	230	3.2	175	322	Palka *et al*. (under review)
Fin whale	0.66	805	3.2	336	137	Gauffier *et al*., 2018

Due to the low number of sightings throughout the blocks, several contiguous blocks were merged to improve variance and confidence estimation. Blocks were only merged if they contained sightings and shared similar bathymetry. When using just the ASI data from 2018, there were enough sightings of striped dolphins (92 on transect plus 38 off transect) to generate detection functions using only striped dolphin encounters (Table 25). However, there weren't enough sightings of the other dolphin species to generate detection functions using the ASI data alone. Therefore, sightings of striped dolphins were additionally used to generate the dolphin detection functions when using only the 2018 data (Table 26-Table 29). As there were no other species in the Mediterranean with approximately similar conspicuousness and surfacing behaviour, the ASI-only dataset for fin whales only included the 17 on track sightings (plus the seven off track sightings to contribute to the detection function; Table 30).

Table 25. Summary of detection functions generated for sightings made from Song of the Whale in 2018. Detection functions were generated using only the ASI data where possible; however, a lack of on-track sightings of common, bottlenose and Risso's dolphins meant the 2018 detection functions for these species were generated using striped dolphin sightings as well (*). Pooled detection functions were additionally generated using Song of the Whale datasets from 2003 to 2018. Estimations of density were corrected for availability bias using the values for g(0) in Table 9.

Species	**Detection function**	**Model**	**Covariates included in final model**	**Truncation distance (m)**	**ESHW (m)**
Striped dolphin	ASI-only	Hz+cos	Platform + observers + swell	1500	224
	Pooled	Hz+cos	Platform	1500	291
Common dolphin	ASI-only*	Hz+cos	Platform	1500	365
	Pooled	Hz+cos	Platform + observers	1500	159
Bottlenose dolphin	ASI-only*	Hz+cos	None	1500	137
	Pooled	Hz+cos	Platform + sea state	1500	263
Risso's dolphin	ASI-only*	Hz+cos	None	1500	134
	Pooled	Hz+cos	Platform + swell	1500	206
Fin whale	ASI-only	Hz+cos	Platform + sea state	2000	623
	Pooled	Hz+cos	Platform + sea state + time	2000	494

There was a high degree of variability in the estimates of density and abundance for most species. The high level of uncertainty in these estimates is likely due to low sample sizes, and the subsequent lack of multiple transects within each block having more than one encounter. Estimates of density and abundance generated using either the 2018 or the pooled dataset were broadly similar for most species, with both estimates being typically within ±20% of each other. Although coefficients of variance were typically lower when incorporating the 2003-2018 datasets, the results suggest the sample sizes in 2018 alone may have been adequate for generating a detection function for several species. However, the estimates for bottlenose dolphins varied significantly depending on whether the detection function was generated using 2018 sightings (supplemented with 2018 sightings of striped dolphins) or the pooled dataset of sightings of bottlenose dolphins from 2003 to 2018, with the ASI-only estimates being almost twice as high as the pooled estimates. The shapes of the detection functions were quite different, with the ASI-only curve being narrow with a rapid roll-off; this may relate to behavioural differences between bottlenose dolphins in the Mediterranean compared with those Atlantic individuals also included in the pooled datasets.

Table 26. Summary of density and abundance estimates for sightings of striped dolphins made from *Song of the Whale* in 2018. A detection function was generated using only the ASI data, with an additional pooled detection function generated using *Song of the Whale* datasets from 2003 to 2018.

Detectio n function	**Block(s)**	**cv**	**Densit y(*D*)**	***D* conf. interva l**	**Abundanc e (*N*)**	***N* conf. interva l**
ASI-only	2	19.5	2.605	1.78-3.82	125,700	85,818-184,110
	3+6	36.8	0.259	0.13-0.53	37,153	18,096-76,278
	4+5+7+8	39.1	1.125	0.53-2.40	338,390	158,550-722,250
	9+10	92.6	1.298	0.00-585	72,802	161-32,829,000
	12+13+14+1	27.6	0.271	0.16-0.46	60,013	35,019-102,840
	22	39.0	0.276	0.09-0.87	23,913	7,600-75,246
	26	104.	0.021	0.00-240	2,854	0-32,636,000
	Total	28.1	0.666	0.38-1.16	660,830	379,850-1,149,600
Pooled	2	4.8	2.106	1.92-2.31	101,620	92,543-111,580
	3+6	31.6	0.209	0.11-0.40	30,035	15,869-56,846
	4+5+7+8	34.3	0.909	0.46-1.80	273,560	138,500-540,340
	9+10	90.7	1.049	0.00-1182	58,854	52-66,282,000
	12+13+14+1	20.1	0.219	0.15-0.33	48,515	32,278-72,919
	22	34.1	0.223	0.05-1.00	19,332	4,337-86,167
	26	103.	0.017	0.00-763	2,307	0-103,720,000
	Total	20.8	0.538	0.35-0.83	534,220	345,410-826,230

Table 27. Summary of density and abundance estimates for sightings of common dolphins made from *Song of the Whale* in 2018. * A lack of on-track sightings meant a reliable detection function could not be generated using the ASI data alone; therefore a 2018 detection function was generated using striped dolphin sightings as well. An additional pooled detection function was generated using *Song of the Whale* datasets from 2003 to 2018.

Detection function	**Block(s)**	**cv**	**Density (*D*)**	***D* conf. interval**	**Number (*N*)**	***N* conf. interval**
ASI-only*	1	27.5	0.048	0.03-0.08	4,464	2,600-7,664
	2	68.5	0.350	0.01-8.72	16,915	680-420,970
	3+6	62.4	0.627	0.18-2.20	89,879	25,597-315,590
	5+7	54.8	0.467	0.04-5.59	34,165	2,855-408,900
	13+14	62.5	0.100	0.02-0.42	14,636	3,515-60,940
	Total	43.8	0.317	0.13-0.75	160,060	67,435-379,900
Pooled	1	6.5	0.040	0.04-0.05	3,726	3,279-4,234

2	63.1	0.293	0.00-40.1	14,119	103-1,933,100
3+6	56.4	0.523	0.15-1.77	75,022	22,154-254,060
5+7	47.8	0.390	0.00-77.2	28,517	144-5,643,900
13+14	56.5	0.084	0.02-0.37	12,217	2,742-54,419
Total	34.7	0.265	0.13-0.56	133,600	63,119-282,790

Table 28 Summary of density and abundance estimates for sightings of bottlenose dolphins made from *Song of the Whale* in 2018. *A lack of on-track sightings meant a reliable detection function could not be generated using the ASI data alone; therefore a 2018 detection function was generated using striped dolphin sightings as well. An additional pooled detection function was generated using *Song of the Whale* datasets from 2003 to 2018.

Detection function	**Block(s)**	**cv**	**Density (*D*)**	***D* conf. interval**	**Number (*N*)**	***N* conf. interval**
ASI-only*	1	75.9	0.497	0.02-16.5	46,526	1,405-1,540,500
	2	36.3	0.108	0.05-0.22	5,232	2,594-10,429
	4	36.3	0.379	0.19-0.76	34,930	17,316-69,621
	14	75.0	0.092	0.02-0.48	7,235	1,357-38,118
	Total	49.4	0.300	0.09-1.00	93,924	27,990-311,400
Pooled	1	67.8	0.259	0.00-209	24,251	30-19,619,000
	2	12.4	0.057	0.04-0.07	2,727	2,126-3,458
	4	12.4	0.198	0.15-0.25	18,207	14,190-23,082
	14	68.0	0.093	0.01-0.57	7,296	1,162-45,252
	Total	34.5	0.168	0.02-1.12	52,482	7,776-349,990

Table 29. Summary of density and abundance estimates for sightings of Risso's dolphins made from *Song of the Whale* in 2018. *A lack of on-track sightings meant a reliable detection function could not be generated using the ASI data alone; therefore a 2018 detection function was generated using striped dolphin sightings as well. An additional pooled detection function was generated using *Song of the Whale* datasets from 2003 to 2018.

Detection function	**Block(s)**	**cv**	**Density (*D*)**	***D* conf. interval**	**Number (*N*)**	***N* conf. interval**
ASI-only*	3	40.1	0.344	0.16-0.74	30,542	14,225-65,574
	4+5	47.3	0.548	0.17-1.06	80,324	24,489-155,400
	Total	44.0	0.471	0.16-0.84	110,860	36,638-197,870
Pooled	3	24.2	0.223	0.14-0.36	19,831	12,252-32,099
	4+5	34.8	0.356	0.16-0.78	52,156	23,899-113,820
	Total	30.2	0.306	0.16-0.58	71,987	38,288-135,350

Table 30. Summary of density and abundance estimates for sightings of fin whales made from *Song of the Whale* in 2018. An additional pooled detection function was generated using *Song of the Whale* datasets from 2003 to 2018.

Detection function	Block(s)	cv	Density (*D*)	*D* conf. interval	Number (*N*)	*N* conf. interval
ASI-only	4	18.9	0.016	0.01-0.02	1,494	1,007-2,215
	7	18.9	0.013	0.01-0.02	957	0,645-1,419
	8a	18.9	0.056	0.04-0.08	1,928	1,300-2,860
	8b	72.7	0.055	0.01-0.33	2,563	0,423-15,534
	10	34.5	0.036	0.01-0.09	1,238	0,488-3,140
	Total	29.3	0.029	0.02-0.06	8,180	4,314-15,512
Pooled	4	9.0	0.025	0.02-0.03	2,345	1,962-2,803
	7	9.0	0.021	0.02-0.02	1,502	1,257-1,795
	8a	9.0	0.088	0.07-0.11	3,027	2,533-3,619
	8b	70.6	0.096	0.01-0.65	4,497	0,666-30,367
	10	30.3	0.057	0.02-0.17	1,943	0,656-5,758
	Total	25.7	0.047	0.02-0.09	13,315	6,798-26,082

III.2.5.2 Sightings from other vessel surveys

Due to some uncertainties in species ID and the low sample sizes for several of the species seen during the other vessel surveys, density estimates were derived for a generic ‘small odontocete’ group rather than individual species. The ‘small odontocete’ group thus included sightings of bottlenose, common, rough- toothed and striped dolphins, plus ‘probable’ and ‘possible’ sightings of Risso’s dolphins and false killer whales. Detection functions were derived using both a composite detection function generated using an ASI-only dataset containing only those sightings made from all vessels in 2018/19, and the ASI data in conjunction with previous datasets collected from R/V Song of the Whale from 2003 to 2018. This allows an assessment of the feasibility of a basin-wide survey conducted every few years without any prior data collection. Using ‘vessel’ as a covariate did not improve the accuracy of the model (based on AIC scores) and therefore the shape of the detection functions generated for the other vessels were not significantly different from those derived from the Song of the Whale data (Table 31). Thus, generating density estimates using a composite detection function does not appear to be inappropriate.

Table 31. Summary of detection functions generated for sightings of small odontocetes made from the other vessel surveys in 2018/19. Detection functions were generated using both the ASI-only data and pooled data incorporating *Song of the Whale* datasets from 2003 to 2018.

Species	Detection function	Model	Covariates included in final model	Truncation distance (m)	ESHW (m)
Small odontocete	ASI-only	Hz+cos	None	1600	243
	ASI plus SOTW	Hz+cos	None	1600	227

Estimations of density were corrected for availability bias generated using the Song of the Whale datasets from 2003 to 2018, with g(0) for striped, common and bottlenose dolphins estimated as 0.996 (Table 25). Estimates of density and abundance for small odontocetes generated using either the ASI-only or the pooled data were very similar (Table 32), suggesting the sample size of sightings made by vessels during the ASI alone may have been adequate for generating a detection function for small odontocetes. The outputs suggest there were at least twenty thousand small odontocetes (i.e., bottlenose dolphins, common dolphins, Risso's dolphins, striped dolphins and false killer whales) in the waters of Egypt, Lebanon and Syria in 2018/19 (Figure 52). As only bottlenose dolphins were encountered in Lebanese waters, it is reasonable to assume the estimate of 2,500 dolphins in block 32 applies to just bottlenose dolphins.

Table 32. Summary of density and abundance estimates for sightings of small odontocetes made from the other vessel surveys in 2018/19. Detection functions were generated using both the ASI-only data and pooled data incorporating *Song of the Whale* datasets from 2003 to 2018.

Detectio n function	Bloc k	cv	Densit y (*D*)	*D* conf. interva l	Numbe r (*N*)	*N* conf. interva l
ASI-only	27	33.	0.09	0.04-0.17	7,376	3,757-14,484
	28	61.	0.22	0.06-0.79	11,683	3,227-42,295
	31	41.	0.13	0.05-0.31	519	219-1,230
	32	62.	0.64	0.07-5.86	2,523	277-23,000
	Total	38.	0.15	0.07-0.34	20,101	10,030-48,698
ASI plus SOTW	27	26.	0.09	0.05-0.16	7,341	4,091-13,175
	28	57.	0.21	0.06-0.75	11,268	3,140-40,441
	31	36.	0.13	0.06-0.31	536	234-1,228
	32	58.	0.64	0.05-8.81	2,508	181-34,686
	Total	32.	0.15	0.07-0.31	21,653	10,567-44,371

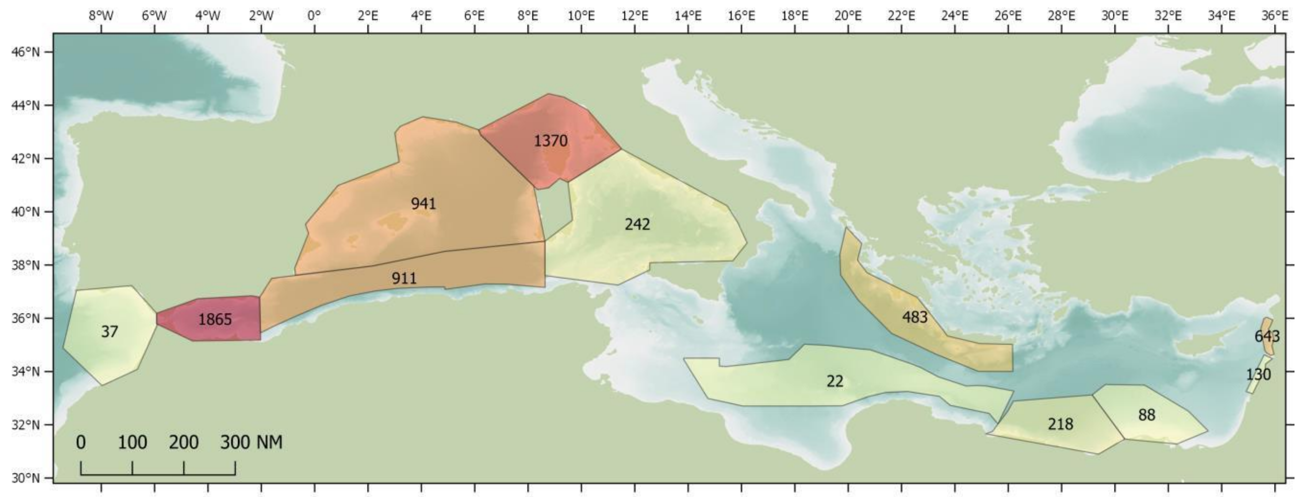


Figure 52. Densities (numbers represent individuals per 1000 km^2) of small odontocetes seen by all vessels during 2018/2019. In addition to the Egyptian, Lebanese and Syrian surveys, densities are provided for the sightings made in the Song of the Whale merged blocks.

III.2.6 Acoustic detections from R/V Song of the Whale

III.2.6.1 Sperm whales

Sperm whales were detected acoustically throughout the western basin of the Mediterranean Sea, with additional detections being made in the contiguous region in the approaches to the Strait of Gibraltar (Figure 53). A total of 249 individual sperm whales were detected on the track-line during the ASI surveys from R/V *Song of the Whale*; an additional 71 individuals were detected off the track-line. In comparison, sperm whales were seen only ten times on the track-line, with 16 sightings made off-track.

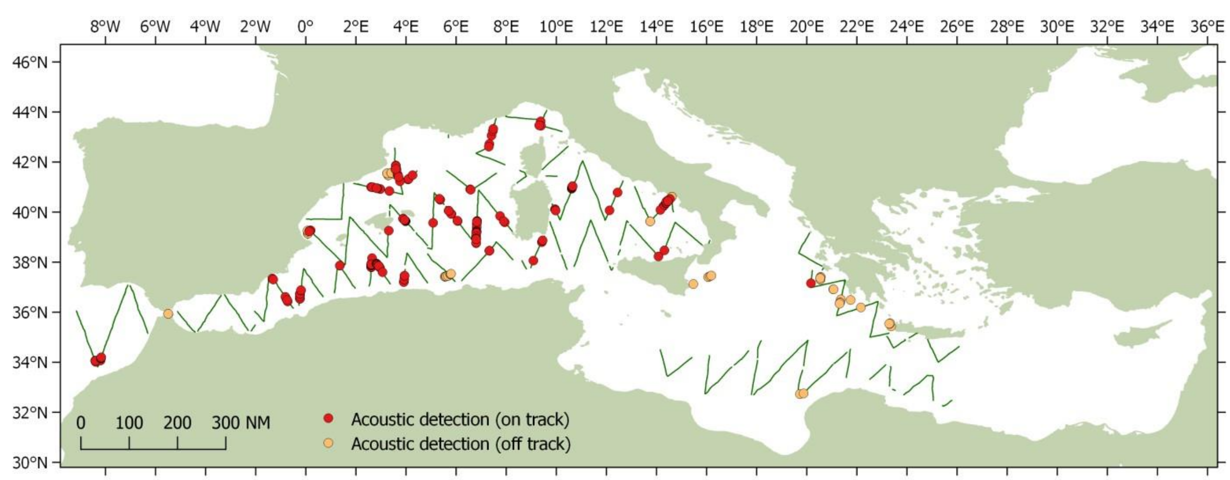


Figure 53. Sperm whale acoustic detections from R/V *Song of the Whale* during the ASI survey. Individual whales detected on the track line are shown as red circles (n = 249); whales off-track are shown as orange circles (n = 71). Those sections of track survey using acoustic effort are shown as green lines.

Distances estimated in Pamguard were subsequently imported into the Distance software to generate acoustic detection functions and density estimates using MCDS. Only the 249 detections made whilst on transect and following the survey protocol (i.e., 5-8 knots) were used. The perpendicular distance data were right truncated at 10,000 m prior to the analysis, excluding 5% of the largest distance estimates. The covariates described above (vessel heading, vessel speed, engine revs, wind speed, wind direction, sea surface temperature, sea state, swell height and rain condition) were used to modify the detection functions. All covariates and combinations of them were incorporated into model generation. Models were initially generated with single covariates; models combining two and three covariates were subsequently generated. The selection of the best detection function was made using Akaike's Information Criterion (AIC).

A hazard key function with a cosine adjustment term generated detection functions with the closest fit to the distance estimates based on AIC scores. Inclusion of wind speed had the most pronounced effect on the detection function, deriving the lowest AIC score. Addition of additional covariates did not improve the fit of the model and thus only this covariate was included in the final model. Higher wind speeds tended to be associated with more distant detections of sperm whales (i.e., a broadening of the detection function). Although high winds at the sea surface increase ambient noise levels, and thus may make it harder to detect sperm whale clicks, they may also promote mixing of the water column. This mixing action may remove any pronounced thermoclines that have the potential to reflect or refract the vocalisations of sperm whales produced at depth, thus modifying the estimates of perpendicular distance. A goodness-of-fit test suggested the detection function incorporating wind speed adequately represented the perpendicular distances (χ^2 = 8.48, p = 0.205). The *esw* was 3963 m (Figure 54).

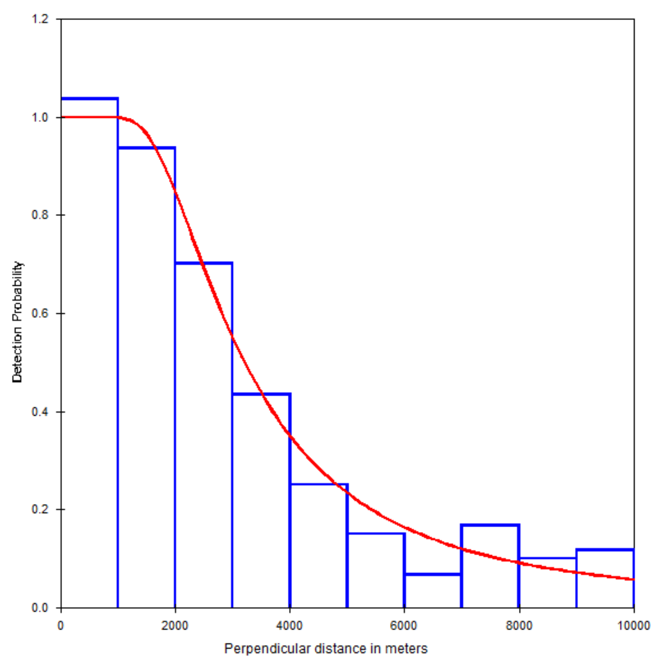


Figure 54. The detection function generated using MCDS (hazard rate key with cosine adjustment). The covariate wind speed was used in the final model. *esw* was estimated as 3963 m.

A quantile-quantile plot was also generated to assess the adequacy of the model fit (Figure 55). The fit was adequate, with most points close to the line and little systematic departure.

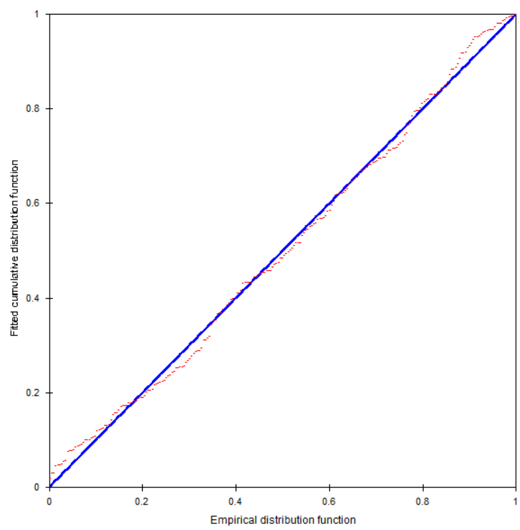


Figure 55. A quantile-quantile (qq) plot using exact data (i.e. not transformed into intervals).

In the absence of detailed information of the vocal behaviour of individual sperm whales during the ASI surveys, for example via the application of suction-cup tags, the acoustic availability of sperm whales was taken from a Monte Carlo simulation performed by Fais *et al.*, 2016 for tagged sperm whales recorded in the Canary Islands. An estimate for g(0) of 0.872 (sd = 0.069) was derived using an esw (ESHW) of 4 km and average survey speed of 6 knots; this value was used to scale subsequent estimates of density. By incorporating this estimate of availability bias, MCDS was used to generate density estimates for those blocks with a sufficient number of on-track detections (Table 33). A total abundance estimate of approximately 4,600 individual sperm whales was derived for the blocks surveyed, which included most of the known habitat for sperm whales in the Mediterranean Sea.

Table 33. MCDS output including abundance (N) for each survey block using wind speed as a covariate; detection functions were derived with hazard rate key with cosine adjustment. * denotes those strata for which encounter rate variance could not be estimated empirically as all detections were made on the same transect (encounter rate variance set to zero in these instances). Abundance estimates from other studies are also presented; the study regions used in the other studies do not necessarily align closely with survey blocks used for the ASI surveys.

Block	**Individuals per km^2**	***N***	**CV**	**95% conf. interval**	**Other estimate**	**Study**
01: Gulf of Cadiz	0.004	334	16.1	91-1231		
03: West Algeria	0.012	1067	34.4	457-2492		
04: Balearics	0.005	436	58.5	44-4357	~400	Rendell *et al.*, 2014
05: Northeast Spain	0.009	462	20.2	69-3074		
06: Algeria East*	0.002	130	5.2	118-144		
07: West Sardinia	0.005	347	52.8	73-1653		
8a: Gulf of Lion (shelf) *	0.007	244	5.2	220-270	~160	Laran *et al.*, 2017b
8b: Gulf of Lion (deep)	0.004	173	61.7	0-18733	~210	Laran *et al.*, 2017b

09: Pelagos (SW)	0.005	175	5.2	158-194		
10: Pelagos (NW)*	0.002	78	26.7	5-1287		
11: Pelagos (E)	0.006	157	8.3	118-209		
12: Tyrrhenian (centre west)	0.001	19	5.2	17-21		
13: Tyrrhenian (centre east)	0.020	1365	7.1	1126-1655		
14: Tyrrhenian (south west)*	0.004	276	5.2	250-306		
15: Tyrrhenian (south east)	0.001	33	8.3	25-44		
22: Hellenic Trench*	0.002	81	5.2	73-90	200-250	Frantzis *et al*., 2014
Total	0.005	4599	16.7	3127-6763	~1800	Lewis *et al*., 2018

III.2.6.2 Small odontocetes

Recordings made at a sampling rate of 192 kHz encompass the known bandwidth of most odontocete vocalisations (2-96 kHz), and thus are suitable for detecting beaked whales, sperm whales and all other small/medium species. Dolphin clicks and/or whistles were detected throughout the study area (*n* = 980), with highest densities in the western basin (Figure 56). The largest aggregations of dolphins detected acoustically were in the contiguous Atlantic regions, with a maximum group size of approximately 40 individuals. A gradient of group size was evident, meaning smaller groups were encountered as the surveys headed eastwards. Although densities were at their lowest in the eastern basin, multiple groups of dolphins were detected acoustically in the Hellenic Trench, albeit in small clusters.

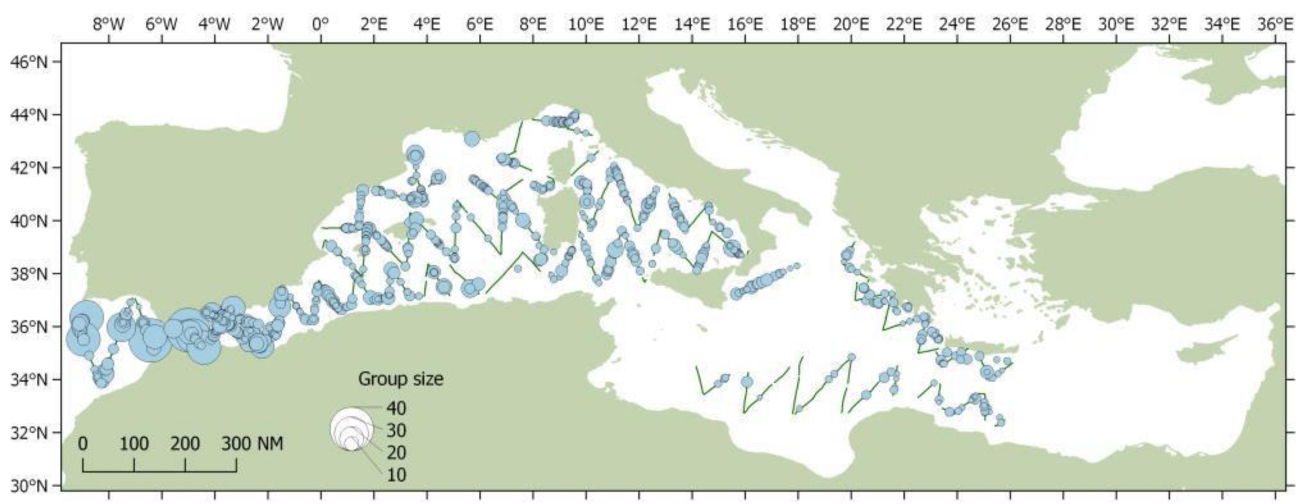


Figure 56. Acoustic detections of small/medium odontocetes made during the *Song of the Whale* acoustic surveys of summer 2018. The surface area of the symbols is proportionate to group size.

III.2.6.3 Cuvier's beaked whale

A total of 31 detections of beaked whale clicks were made during the ASI surveys (Figure 57); of these, 21 were considered to be 'definite' ziphiid clicks, the remaining 10 detections having a lower confidence of 'probable'. On average, beaked whale detections were made up of approximately 27 clicks. Estimated groups sizes were small (< four individuals) which is in keeping with typical group sizes reported for sighting of Cuvier's beaked whale in the Mediterranean Sea. All detections were made in water depths between 800 and 3,400 m (mean = 1,715 m).

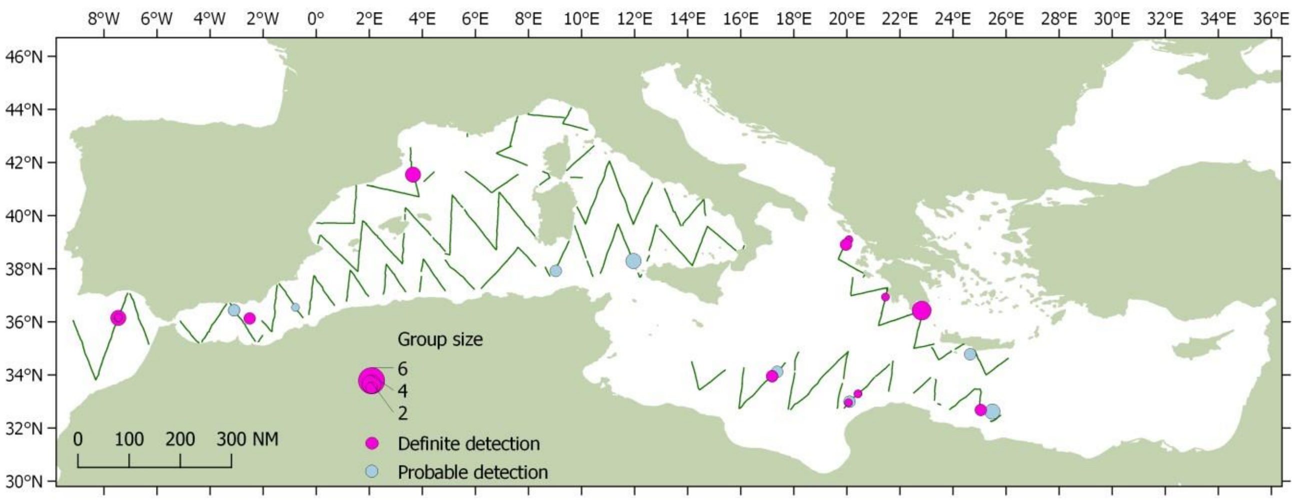


Figure 57. Acoustic detections of beaked whales made during the *Song of the Whale* acoustic surveys of summer 2018. The surface area of the symbols is proportionate to group size.

III.2.6.4 Anthropogenic noise

The towed hydrophone array was monitored every 15 minutes and the species and/or acoustic events heard were logged on a subjective scale of 0 (i.e., not heard) to 5 (i.e. nothing else audible). These data have not been validated and must be considered with caution; however, summary plots are provided for anthropogenic noise from military sonar and seismic surveys (Figure 58) and shipping (Figure 59).

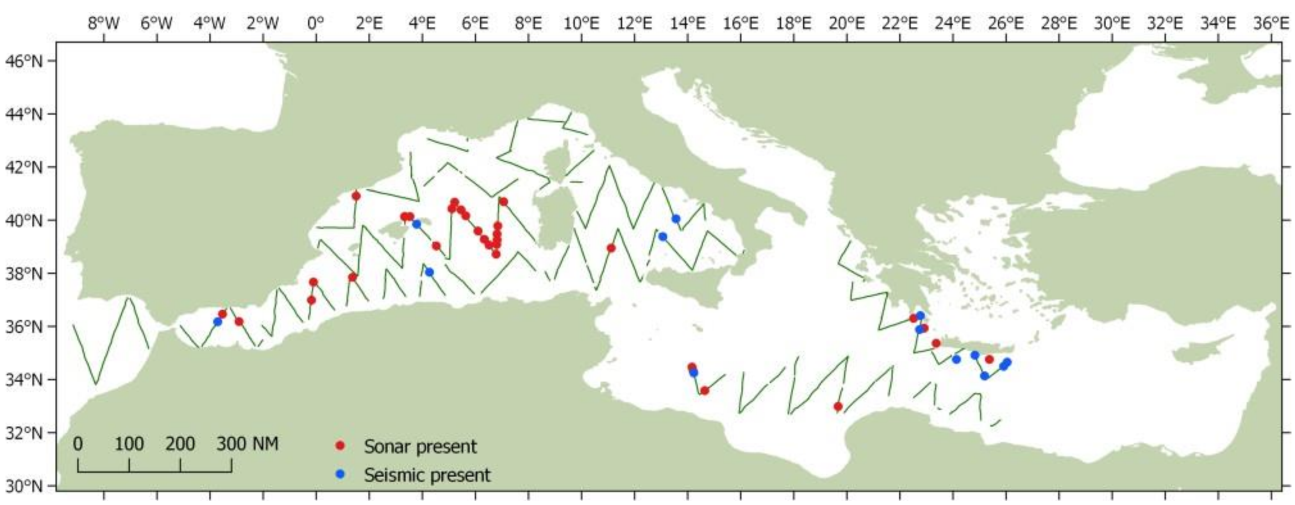


Figure 58. Listening posts at which sonar signals and/or seismic airguns were heard. Note: although subjective, each data point represents a unique detection (i.e., a separate operation).

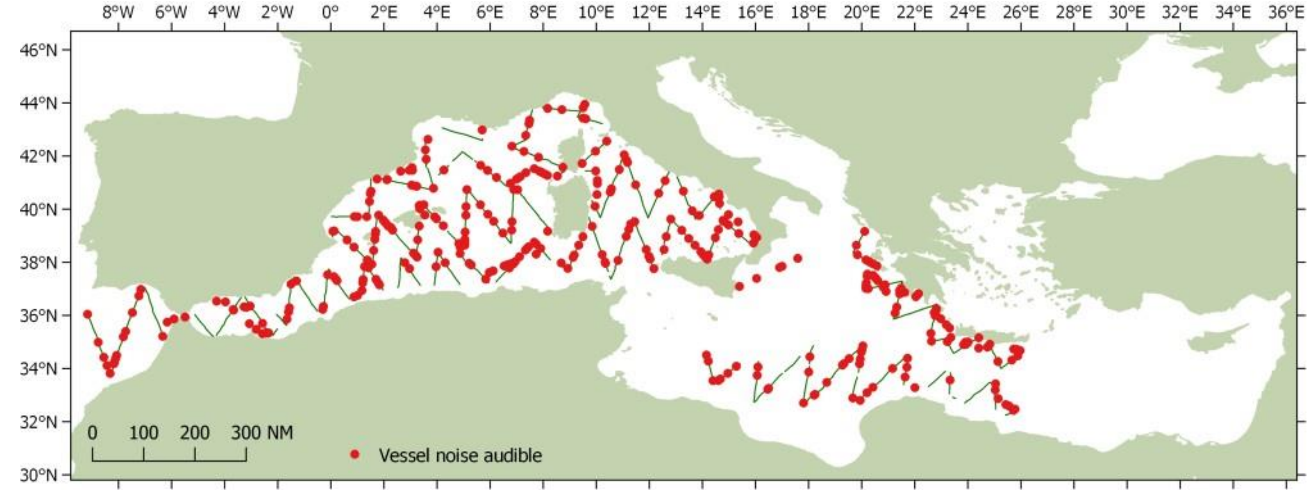


Figure 59. Listening posts at which ship noise was heard. Note: although subjective, each data point represents a unique detection (i.e., a separate vessel).

III.2.7 Archiving of survey data

Copies of all acoustic recordings (as wav files) and Pamguard binary storage files collected in the field have been archived with ACCOBAMS along with all field databases. Data Tables for the online exchange of ASI data have been provided. Spreadsheets of validated sightings and acoustic detections have been/will be provided to ACCOBAMS.

III.3. SYNTHESIS AND GENERAL CONSIDERATIONS

The vessel-based surveys of the ACCOBAMS Survey Initiative were conducted from five vessels between May 2018 and November 2019. The survey blocks were the same as those designed for the ASI aerial component, with some changes made due to permitting or security constraints. Although the intention was for all vessel surveys to be conducted concurrently with the aerial surveys in July 2018, this was only possible for the *Song of the Whale* transects due to ongoing security and logistical considerations in Egypt, Lebanon and Syria. The vessel surveys incorporated more than 23,000 km of survey effort over 43 degrees of longitude. Confirmed sightings were made of nine cetacean species: common bottlenose dolphin, common dolphin, Risso's dolphin, rough-toothed dolphin, striped dolphin, long-finned pilot whale, Cuvier's beaked whale, sperm whale and fin whale, with a possible sighting of a tenth species, false killer whale, made in the waters of Egypt.

The Song of the Whale team conducted acoustic surveys, in addition to standard visual effort, from the contiguous region in the Atlantic to the Tyrrhenian Sea (blocks 1 to 15); additional surveys were conducted in Libyan waters (blocks 25 and 26) and the Hellenic Trench (block 22). The acoustic effort provided additional confidence in the density estimates for deep-diving species that may have been under- represented in the aerial surveys. An estimate of 4,600 sperm whales was derived for those areas surveyed; as these represent most of the known sperm whale habitat in the Mediterranean Sea, this number may be considered representative of the entire ACCOBAMS region. In addition to the acoustic density estimates, the visual effort was used to derive density estimates for striped dolphins (480,000) and common dolphins (95,000).

The four other vessel surveys took place in Egypt (blocks 27 and 28), Lebanon (block 31) and Syria (block 32). Due to some uncertainties in species ID and the low sample sizes for several of the species reported during these surveys, density estimates of 20,000 individuals were derived for a generic 'small odontocete' group rather than individual species.

III.3.1 Sperm whales

Sperm whales were detected acoustically throughout the western basin of the Mediterranean Sea, with additional detections being made in the contiguous region in the approaches to the Strait of Gibraltar. The detection of two sperm whales off Libya represents only the second documented encounter with this species in Libyan waters; the first encounter was an individual encountered by the *Song of the Whale* team in 2007 (Boisseau *et al*., 2010). Sperm whales have been reported in Tunisian waters, and have stranded in Libya and Egypt, suggesting the area appears to be used intermittently by this species. It is also noteworthy that sperm whales were detected acoustically in the Strait of Gibraltar, a globally important shipping lane that is also a region defined as "critical for cetaceans" (IMO document MEPC 58/Inf. 15). In this area, an advisory speed limit of 13 knots is in effect from April to August; however, this is not currently mandatory.

In the western basin, the *Song of the Whale* results closely match the regions predicted to support the highest densities of sperm whales in the Mediterranean Sea (Mannocci *et al*., 2018b; Figure 60); in the eastern basin, detections were sparse compared to the western basin and tended to be in those regions identified as having relatively high densities, such as the Hellenic Trench. Additional detections were made in the contiguous region on the approaches to the Strait of Gibraltar.

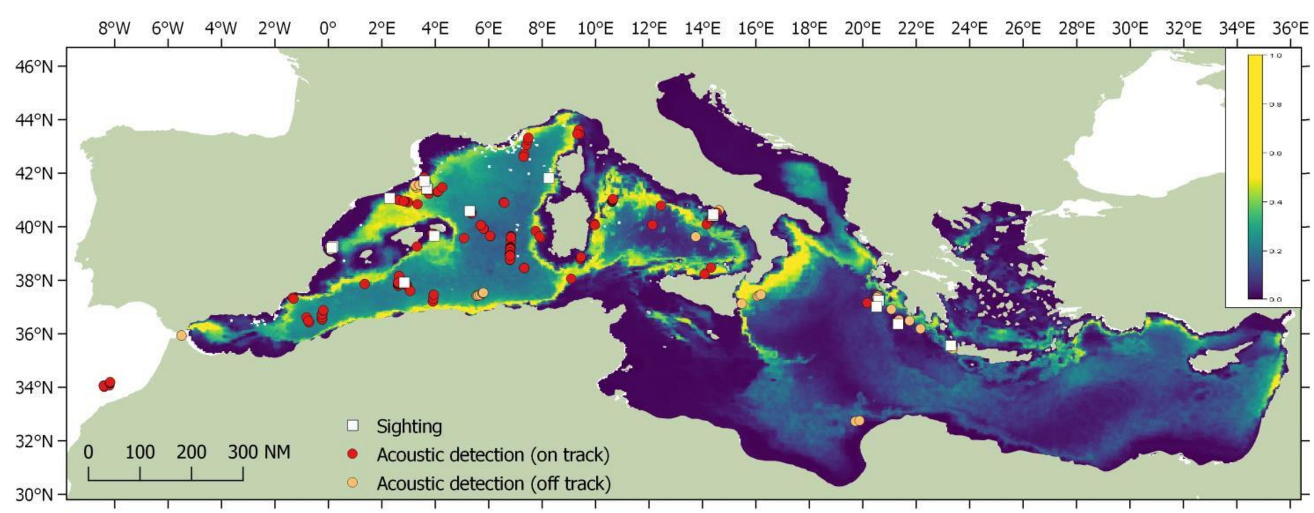


Figure 60. Sightings and detections of sperm whales made by the *Song of the Whale* team during the ASI survey (white squares and red/orange circles respectively). A predicted density map from Mannocci *et al*., 2018b is overlaid showing regions of ideal sperm whale habitat (yellow = highest likelihood, blue = lowest likelihood).

From the blocks surveyed during the ASI by the Song of the Whale team, a total abundance estimate of approximately 4,600 individual sperm whales was derived for the blocks surveyed; these included most of the known habitat for sperm whales in the Mediterranean Sea. A previous composite study by the Song of the Whale team had estimated an abundance estimate of 1,842 sperm whales in the Mediterranean Sea (Lewis *et al*., 2018). However, that study included acoustic data collected over multiple field seasons and several non-consecutive years from two different research vessels (Song of the Whale I and II); it additionally utilised visual results from aerial surveys (Laran *et al.,* 2017b) to supplement data gaps, and used average values for those regions without any survey effort. Despite these limitations, (Lewis *et al.,* 2018) provided the first attempt at estimating sperm whale numbers throughout the ACCOBAMS region. The new estimate derived from the ASI surveys provide a more consistent density assessment as the data were collected in a single contiguous period in the same year/season from the same vessel with the same field equipment.

Broadly speaking, the estimates from the ASI surveys are in line with these numbers which were typically derived using different techniques; for example, aerial surveys (Laran *et al.,* 2017b) and photo-ID studies (Frantzis *et al*., 2014; Rendell *et al*., 2014). Although the areas surveyed in these other studies are not closely aligned with the block outlines of the ASI survey, they do allow broad comparison (Table 34). The densities derived during the Song of the Whale surveys are plotted in Figure 61, suggesting the regions with highest densities were in the western basin, particularly the Balearic Sea, Ligurian Sea, Tyrrhenian Sea and the Algero-Balearic Basin.

Table 34. Comparison of acoustic density and abundance estimates of sperm whales in the ASI with estimates from other studies. Densities (D) are presented as numbers of individuals per 1,000 km^2 (CV in parentheses); abundance estimates (N) are also presented (95% CI in parentheses). * represents photo-ID studies for which density estimates are not available. The study regions used in the other studies do not necessarily align closely with survey blocks used for the ASI surveys.

Study	**Block name**	***D***	***N***	**ASI equivalent block**	**ASI *D***	**ASI *N***
Rendell *et al*., 2014	Western (Balearics)	*	292 (82-806)	4: Balearics	4.7 (59)	436 (44-4357)
	Eastern (France & Italy)	*	184 (90-353)	10: Pelagos	2.5 (27)	75 (5-1287)
Laran *et al*., 2017b	Slope (France)	3.0 (76)	161 (44-583)	8a: Gulf of Lion	7.1 (5)	244 (220-270)
	Oceanic (France)	2.5 (105)	209 (39-1108)	8b: Gulf of Lion	3.7 (62)	173 (0-18733)
Frantzis *et al*., 2014	Hellenic Trench	*	200-250	22: Hellenic Trench	1.7 (5)	81 (73-90)
Lewis *et al*., 2018	Southern western Med	2.1 (28)	634 (374-1077)	3 & 6: Algeria	8.4 (34)	1197 (575-2636)
	Hellenic Trench	0.3 (47)	39 (15-101)	22: Hellenic Trench	1.7 (5)	81 (73-90)
	Herodotus Rise	<0.1 (113)	5 (1-28)	26: Libya east	0	0

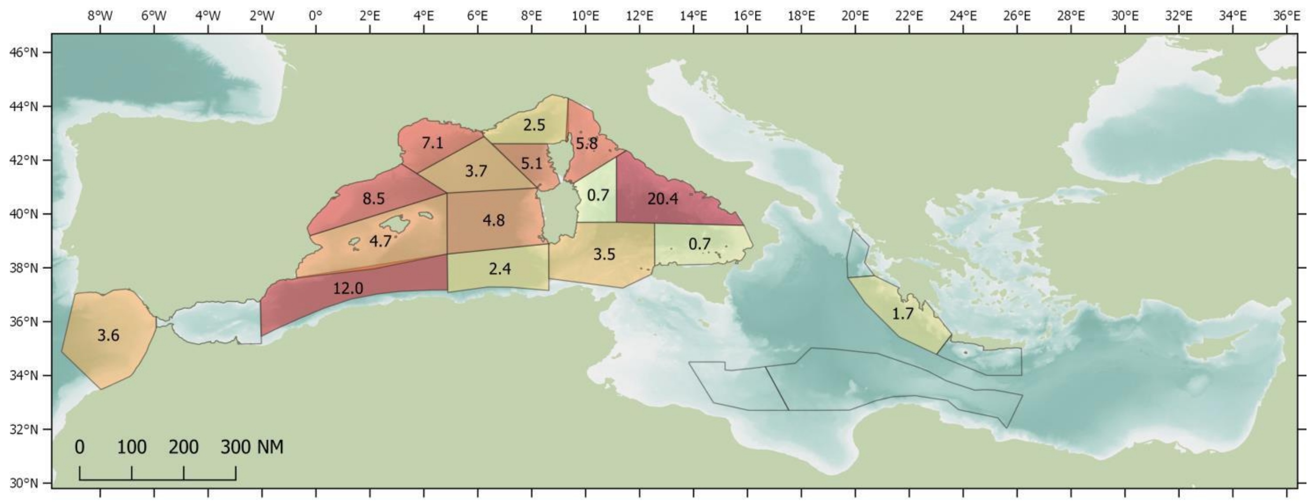


Figure 61. Sperm whale acoustic densities (individuals per 1000 km²) derived for each block surveyed by the Song of the Whale team. Empty blocks represent those areas where no on-track detections were made.

III.3.2 Beaked whales

Although stranded beaked whales have been documented on the Moroccan coast, the *Song of the Whale* team reported what is thought to be the first documented sighting of a living beaked whale in Morocco's Atlantic waters. The team also detected beaked whales in Libyan waters, the first reported encounter for the country. The Egyptian survey teams saw Cuvier's beaked whales in Block 27, the first documented sighting in these waters. Apart from a lack of sightings and detections to the north and east of Corsica and Sardinia, the *Song of the Whale* results closely match the regions predicted to support the highest densities of beaked whales in the Mediterranean Sea (Cañadas *et al.*, 2018). In addition, detections were made in areas not previously predicted to have high beaked whale densities, e.g., to the south of Sardinia (Figure 62). Of note were the several detections and sightings of beaked whales made along the North African coast in the eastern basin, a region that had received little systematic survey effort prior to the ASI surveys. Several detections were made, for example, near the Herodotus seamount in Libyan waters. These findings support the existing evidence that the eastern basin represents an important beaked whale habitat (Baş *et al.*, 2003; Frantzis *et al.*, 2003; Podestà *et al.*, 2016; Cañadas *et al.*, 2018).

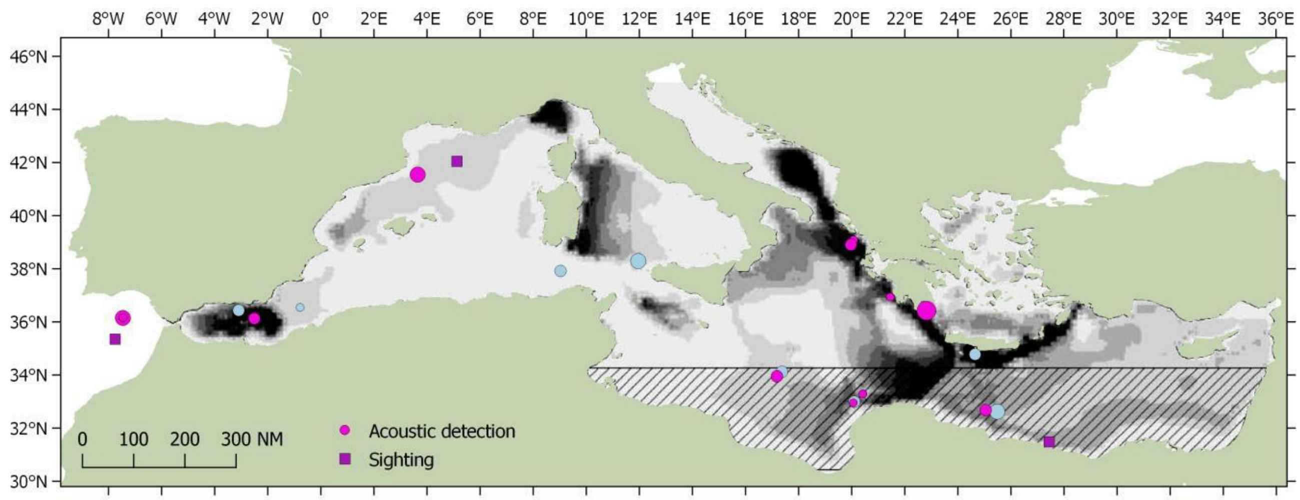


Figure 62. Sightings/detections of beaked whales made by all survey vessels during the ASI survey (pink squares/circles respectively). A predicted density map from Cañadas *et al*., 2018 is overlaid in monochrome showing those regions likely to contain ideal habitat for Cuvier's beaked whale (the predictions in the striped region were considered unreliable due to low sample size).

III.3.3 Striped dolphins

Previous studies have ascertained that the striped dolphin is the most abundant cetacean in the surveyed areas of the Mediterranean Sea (Sciara *et al.*, 1993; Forcada *et al.*, 1994, 1995; de Segura *et al.*, 2006; Laran *et al.*, 2017b; Panigada *et al.*, 2017b). This is confirmed by the ASI data presented here, with an estimate of approximately 600,000 individuals for the blocks surveyed by the *Song of the Whale* team. There may be an additional 20,000 striped dolphins in the waters of Egypt, Lebanon and Syria. Estimates of density and abundance for striped dolphins generated using either the ASI-only or the pooled *Song of the Whale* datasets were broadly similar, suggesting the sample size in 2018 alone may have been adequate for generating a detection function for this species (Figure 63).

As previous studies have identified the most suitable striped dolphin habitat to be in the western basin (Mannocci *et al.,* 2018b), it seems likely that the Song of the Whale surveys included the majority of significant aggregations of this species. The estimate of approximately 130,000 individuals from blocks 9 to 15 (Table 26), was in broad agreement with a 2010 estimate of circa 135,000 striped dolphins from the Pelagos Sanctuary, Central Tyrrhenian and Western Seas of Corsica and Sardinia (blocks A to D in Panigada *et al*., 2017). Although the survey blocks are of inconsistent sizes, the ASI estimates for blocks 9 and 10 (73,000) are higher than those derived from another aerial survey of the Pelagos Sanctuary in summer 2012 (40,000; Laran *et al*., 2017b). However, the neighbouring survey blocks of Laran *et al.* (equivalent to ASI blocks 8a and 8b) contained approximately 90,000 individuals and are likely to act as an interchangeable habitat for striped dolphins in the area, allowing a fluid movement of schools to exploit local prey aggregations moving across block boundaries.

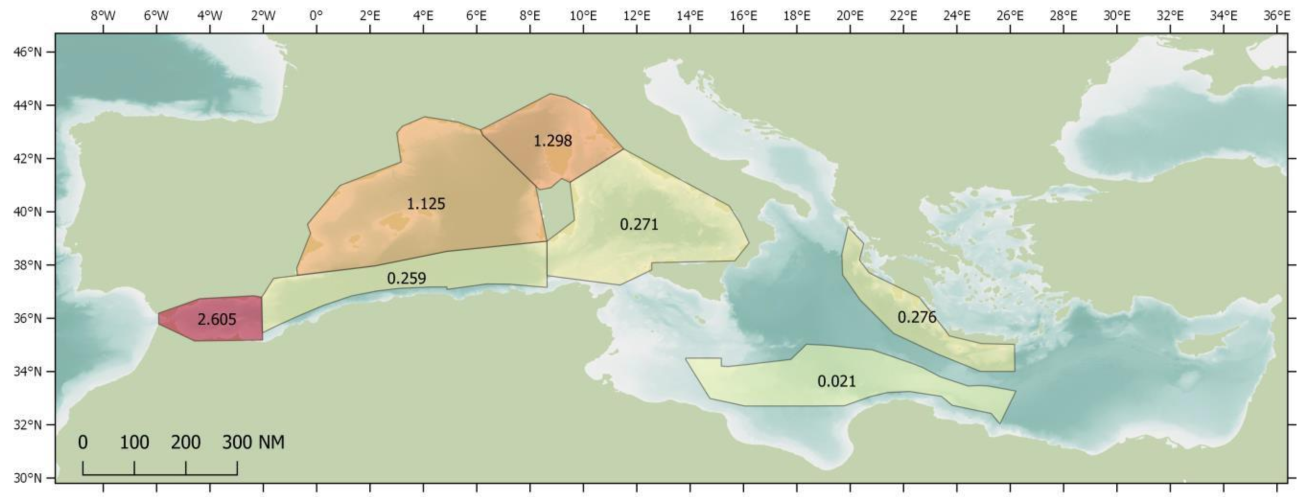


Figure 63. Striped dolphin visual densities (individuals per km^2) derived from R/V Song of the Whale for the merged survey blocks using the ASI-only dataset.

III.3.4 Common dolphins

Estimates of density for common dolphins did not vary drastically depending on whether the detection function was generated using the ASI-only sightings (supplemented with the ASI sightings of striped dolphins; 160,000) or the pooled dataset of sightings of common dolphins reported from R/V Song of the Whale between 2003 and 2018 (134,000). As previous studies have identified suitable common dolphin habitat in the north Adriatic and Aegean Seas, in addition to the western basin (Mannocci *et al*., 2018b), it seems likely that the Song of the Whale surveys did not include the majority of significant aggregations of this species.

Vessel-based surveys of Spanish coastal waters in the Mediterranean derived an estimate of approximately 1.01 dolphins km^{-2} (Cañadas and Hammond, 2008; Cañadas and Vázquez, 2017); the density estimate in this study for block 2 was 0.350 dolphins km^{-2} and this block incorporated much of the area studied by Cañadas & Hammond. However, the Cañadas & Hammond study highlighted geographical variations in density that may have been in response to local productivity, with the high densities to the west of the Alborán Sea perhaps due to the region being more similar to the Atlantic Ocean, and the lower densities towards the Gulf of Vera being in response to the area being hydrographically Mediterranean. The resolution of the ASI blocks was not fine enough to draw these conclusions. Although most studies have suggested the Alborán Sea contains the highest densities of common dolphins in the Mediterranean, higher densities were documented in this study for the Algerian Basin and Balearic Sea i.e., blocks 3 to 7 (Figure 64). It should be noted that the ASI survey represents a short-window snapshot, whereas other studies such as that presented by Cañadas & Hammond (2008) drew on 12 years of survey effort.

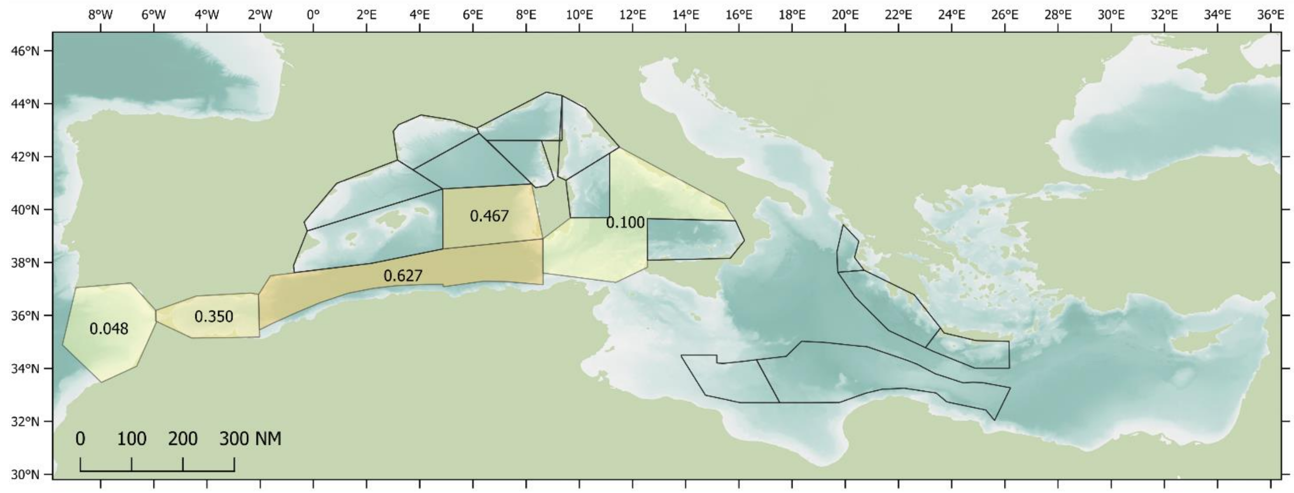


Figure 64. Common dolphin visual densities (individuals per km^2) derived from R/V Song of the Whale for the merged survey blocks using the ASI-only dataset.

III.3.5 Bottlenose dolphins

Unlike the other dolphin species, estimates of density for bottlenose dolphins varied significantly depending on whether the detection function was generated using the ASI-only sightings (supplemented with the ASI sightings of striped dolphins; 94,000) or the pooled dataset of sightings of bottlenose dolphins reported from R/V Song of the Whale between 2003 and 2018 (52,000). The high levels of uncertainty in both estimates (CVs of 49 % and 35 % respectively) is likely due to low sample sizes, and the subsequent lack of multiple transects within each block having more than one encounter. It is likely that pooling striped dolphins with bottlenose dolphins in the ASI-only detection function may significantly distort the shape of the function. Striped dolphins, for example, tended to be in larger groups (median = 8) than bottlenose dolphins (median = 4), and combined with any differences in surface behaviour, striped dolphins may therefore have been more 'available' to observers. Using only bottlenose dolphins from the ASI and the Song of the Whale datasets to generate the detection function may reduce these differences in availability bias, but may be unduly influenced by any geographically variation in behaviour or group size. The median group size for bottlenose dolphins for all surveys in the Mediterranean (i.e., years 2003, 2004, 2007 and 2013) was also 4, for example, but was 8 for all other surveys conducted outside the Mediterranean.

Previous density estimates for bottlenose dolphins have suggested low numbers throughout the Mediterranean. An estimate of 0.049 dolphins km^{-2} was derived for the Alborán Sea in the same proximity to ASI block 2 (Cañadas & Hammond, 2006); the number is similar to the estimate derived in the ASI using the pooled dataset (0.057) although it should be noted that the survey areas (11,402 km^2 in Cañadas & Hammond, 2006 versus 93,631 km^2 in the ASI) and survey effort were quite different (12,568 km and 185 km respectively). An estimate of 0.041 dolphins km^{-2} was derived for the Spanish Mediterranean coast in the same proximity to the western margins of ASI blocks 4 and 5 (Gómez de Segura *et al.*, 2006). Another study in the same proximity to the eastern margins of ASI blocks 4 and 5 estimated densities of ~0.08 dolphins km^{-2} (Forcada *et al.*, 2004). The estimate for block 4 in the ASI surveys was 0.379; however, this estimate was derived using a single on track sighting and should be treated with some caution (Figure 65). In the southern Tyrrhenian Sea, an estimate of 0.043 dolphins km^{-2}

(Lauriano *et al.*, 2014) was derived for an area that incorporated ASI blocks 14 and 15; however, as all of the sightings in that study occurred within the footprint of ASI block 14, it seems the ASI estimate of 0.092 dolphins km^{-2} was of a similar magnitude.

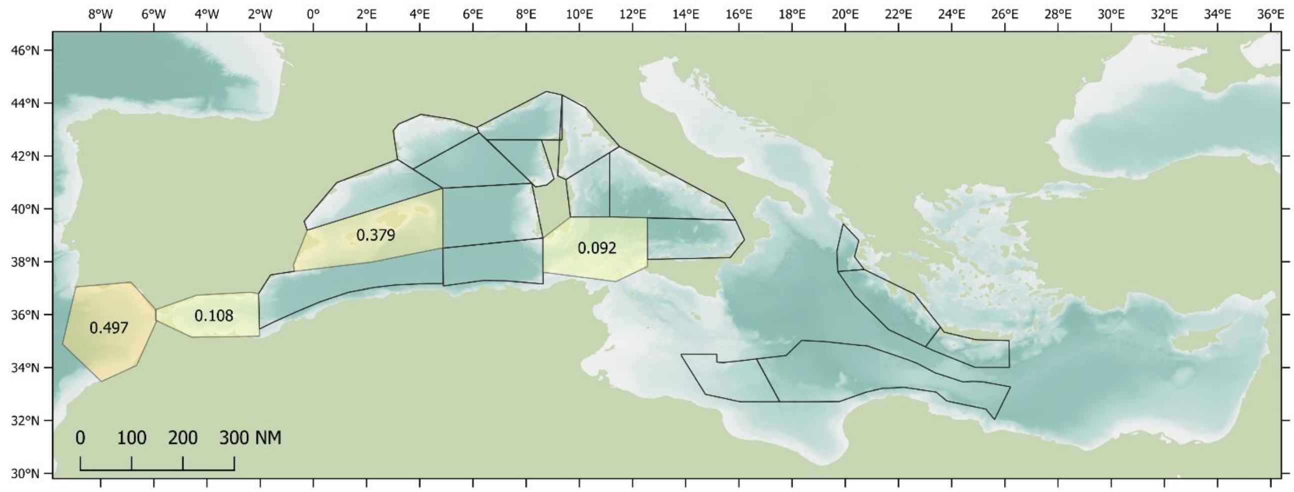


Figure 65. Bottlenose dolphin visual densities (individuals per km^2) derived from R/V Song of the Whale for the merged survey blocks using the ASI-only dataset.

III.3.6 Risso's dolphins

Estimates of density for Risso's dolphins were not too dissimilar depending on whether the detection function was generated using the ASI-only sightings (supplemented with the ASI sightings of striped dolphins; 111,000) or the pooled dataset of sightings of Risso's dolphins reported from R/V Song of the Whale between 2003 and 2018 (72,000). As previous studies have identified suitable Risso's dolphin habitat in the north Adriatic and Aegean Seas, in addition to the eastern extremes of the Levantine basin (Mannocci *et al.*, 2018b), it seems likely that the Song of the Whale surveys did not include the majority of significant aggregations of this species.

An estimate of 0.041 dolphins km^{-2} was derived for the Spanish Mediterranean coast in the same proximity to the western margins of ASI blocks 4 and 5 (Gomez de Segura *et al*., 2006). The estimate for blocks 4 and 5 in the ASI surveys was an order of magnitude higher at around 0.548 (Figure 66); however, this estimate was derived using three on track sightings and should be treated with some caution. An estimate of 0.006 dolphins km^{-2} has been derived for a region broadly similar to ASI blocks 8a and 8b (Laran *et al*., 2017b); no sightings were made during the ASI vessel surveys and thus the estimate for these blocks was zero.

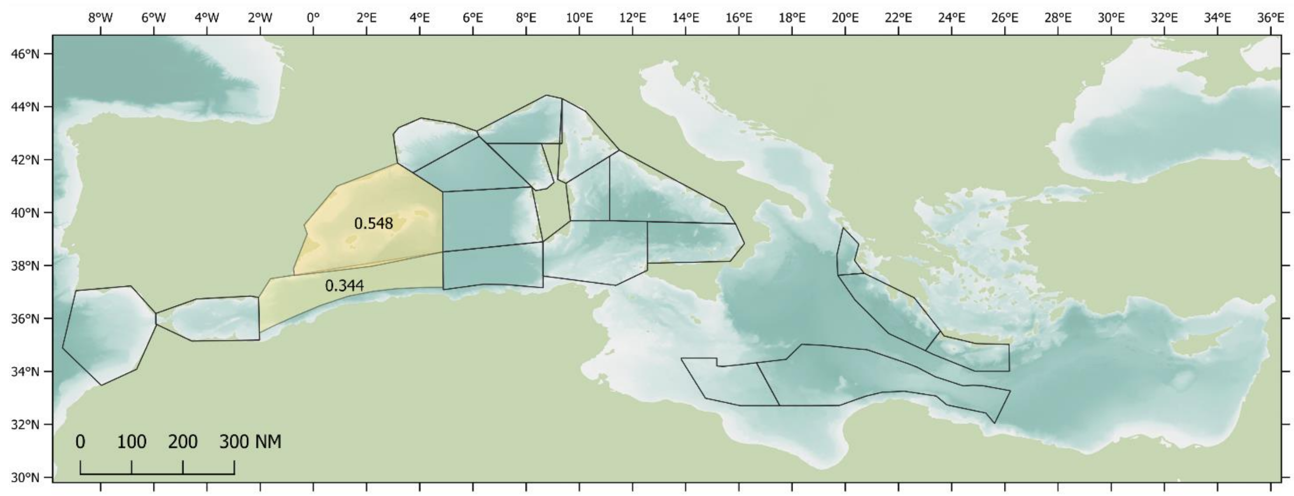


Figure 66. Risso's dolphin visual densities (individuals per km^2) derived from R/V Song of the Whale for the merged survey blocks using the ASI-only dataset.

III.3.7 Fin whales

Estimates of density for fin whales varied depending on whether the detection function was generated using the ASI-only sightings (8,000) or the pooled dataset of sightings of fin whales reported from R/V Song of the Whale between 2003 and 2018 (13,000). For other species, incorporating the previous Song of the Whale datasets would reduce the coefficients of variation for visual density estimates by 21-32 %; however, for fin whales the CV was reduced by only 14 %. This implies using a pooled detection function didn't necessarily improve the density estimates substantially. It seems likely that the Song of the Whale surveys included the majority of significant aggregations of this species (Mannocci *et al*., 2018b).

A summer estimate of 0.002 whales km^{-2} was derived for a region broadly similar to ASI blocks 9, 10 and 11 (Panigada *et al*., 2011) and a summer estimate of 0.016 whales km^{-2} was derived for a region broadly similar to ASI blocks 9 and 10 (Forcada *et al.,* 1995). The ASI vessel surveys derived a much higher estimate than these two studies for block 10 (0.036 whales km^{-2}; Figure 67). An estimate of 0.014 whales km^{-2} was derived for a region broadly similar to ASI blocks 8a and 8b (Laran *et al.*, 2017b); sightings made during the ASI vessel surveys in blocks 8a and 8b derived a higher estimate of 0.055 whales km^{-2} in an area approximately twice that of the region surveyed by (Laran *et al.,* 2017b).

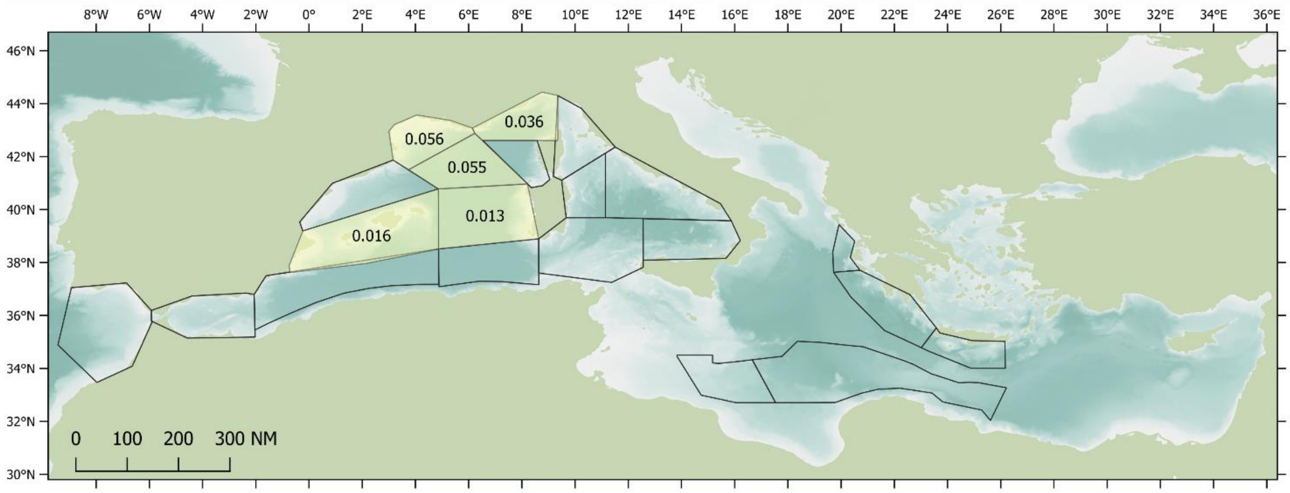


Figure 67. Fin whale visual densities (individuals per km^2) derived from R/V Song of the Whale for the merged survey blocks using the ASI-only dataset.

IV. GENERAL DISCUSSION AND PERSPECTIVES

Although intended and designed to provide different, yet complementary, analytical outputs, there are broad similarities in the results of the ASI research, where data were collected from both aerial and vessel surveys. The distribution of marine mammals throughout the Mediterranean were, in fact, consistent between the two approaches. Fin whales were only encountered west of 12° E of longitude, corresponding to the western part of Sicily. Sperm whales were encountered in every survey block in the western Mediterranean and contiguous Atlantic region, with lower densities evident in the eastern basin survey blocks of the Levantine Basin and Aegean Sea. Cuvier's beaked whales were encountered throughout the Mediterranean, although confined to deeper basins and regions of high slope. Encounters with long-finned pilot whales were restricted to the slope waters running continuously from Portugal to Italy, with two additional groups encountered in the eastern Alborán Sea. Bottlenose dolphins were seen in the shelf waters of most countries surveyed, with occasional sightings made in deep and/or offshore waters. Striped dolphins were found to be widespread, with most groups encountered in or near slope waters. Sightings of common dolphins were sparse and were primarily in a narrow band of latitudes, between 35°N and 40°N (approximately comprised between the northern coast of western Africa to mid Corsica).

It is important, however, to stress out that given the adopted analytical framework, abundance and density values as derived from the two ASI components are not directly comparable. The main reason for this is that aerial survey estimates do not account for availability bias (i.e. the proportion of animals not recorded because unavailable at the surface) and therefore under-represent the real number of individuals for each species. Distance sampling surveys might suffer from biases arising from observers missing animals available at the surface (perception bias) and the above-mentioned availability bias. These two biases are not mutually exclusive and result into underestimates of true abundance and density if not accounted for. Correcting for availability bias usually requires robust knowledge of the diving behaviour and, in general, the diving and surfacing patterns, for a given species. This knowledge for Mediterranean cetaceans is missing for several species and, generally speaking, effort aiming at understanding these patterns has been unevenly allocated across the Basin. Given the general lack of detailed knowledge of cetaceans' movement patterns and diving/feeding behaviours in our study areas, as well as the necessity to avoid using possibly biased averaged dive and surfacing times, in our study, availability biases have not been accounted for when estimating density and abundance from aerial surveys. Accordingly, our estimates represent minimum surface estimates lower than those derived from the vessel surveys. Correction values, arising from specific datasets and previous aerial surveys have been presented and discussed in previous sections, and provide an indication of the percentages of animals missed on the track-line due to availability or perceptions biases.

When comparing density values derived from both aerial and vessel surveys, in both cases highest values for most species were obtained for the western Mediterranean. The main aggregations of fin whales were in the deeper waters of the Liguro-Provençal Basin and the western part of the Pelagos Sanctuary. Sperm whales exhibited clustering throughout the survey blocks, with highest densities clearly present in the southwest Mediterranean. Striped dolphins were found to have their highest densities (>1 individual per km^2) in the Alborán Sea, with high densities also estimated across the Liguro-Provencal Basin. The highest densities of bottlenose dolphins were encountered west of 18°E (eastern tip of Italy). Although Risso's dolphins were seen in both the west and east, highest densities were apparent in the Algerian, Liguro-Provençal and Balearic Basins.

Despite that results arising from the two surveys are comparable, when considering visual detections, coefficients of variation were typically higher for vessel surveys, making the density estimates less reliable. This difference might result from the fact that during the surveys aircrafts moved approximately 15 times faster than vessels surveys, maximising the area coverage per unit of time. On the other hand, for certain species, vessel survey could produce more variable estimates due to attraction to and avoidance of the research platform. As already mentioned above, imperfect species detection during ecological monitoring can lead to biased estimations. This applies to vessel-based surveys as well. During the ASI, for all cetacean groups encountered, species was identified with certainty in 72% of sightings, compared to 77% for the vessel surveys. This could in turn account for the differences in the density values obtained with the two approaches.

Further consideration of possible causes for any variation in estimates is given below for some species.

Common bottlenose dolphin

There were some notable differences in bottlenose dolphin density estimates between the aerial and vessel surveys. The aerial surveys found highest numbers in the northwest portion of the Mediterranean Sea and Alborán Sea, with a total estimate of 31,354 individuals for blocks 1-15; in contrast, the vessel surveys derived a total estimate of 52,482 individuals for blocks 1-15, with almost 50% of these in the Atlantic block and high numbers in Tyrrhenian Sea. As these are snapshot surveys, some of this variability in density estimations may be due to local distribution shifts between the relevant surveys. For example, the northwest blocks were surveyed by the aerial team between 20th June and 6th July, with the corresponding vessel surveys taking place later from 3rd July to 14th July; the southwest was surveyed by air between 1st and 31st July, whilst vessel surveys were earlier, mostly running from 11th and 28th June. An additional possibility for the variation in bottlenose dolphin estimates relates to water depth. Bottlenose dolphins throughout the Mediterranean were largely encountered in shallower waters close to land, as is typical of this species elsewhere. As there are depth limitations for vessel surveys, particularly when towing hydrophone arrays, that do not necessarily apply to aerial surveys, any exclusion of shallower and/or coastal waters may influence vessel-based estimates.

Common dolphin

Density estimates for common dolphin varied markedly between survey type. The vessel surveys found highest densities of common dolphins in the Algerian Basin and Balearic Sea, whereas the aerial surveys derived an estimate of zero for the main body of the western Mediterranean. The vessel surveys found very low densities in the Atlantic (0.04 individuals/km^2) whereas the aerial surveys found high densities (1.05 individuals/km^2). As for the bottlenose dolphin, this strong variability in density estimations between the two surveys could partially result from changes in the spatial distribution of dolphins at the time the vessel and aerial surveys took place. The overall large difference in abundance estimates for blocks 1-15 (133,600 for vessel surveys versus 61,669 for aerial surveys) may possibly relate to the challenge in correctly identifying common dolphins from aerial surveys. Diagnostic patterns and colouration of common dolphins that are evident near sea-level, including the unique 'hourglass' on the flanks that is increasingly yellow near the head and/or the pale sides of the dorsal fin, may not be so readily visible from a plane. When combining estimates of striped and common dolphins for blocks 1-15, abundance estimates are remarkably similar for both techniques (approximately 646 thousand for vessel surveys versus 630 thousand for aerial surveys), suggesting common dolphins may be under-identified during aerial surveys.

Fin whale

There was a high disparity in the abundance estimates between the aerial and vessel surveys. Although a surfacing fin whale may be harder to see at sea level than from the air, when the full body may be visible if conditions are optimal, the tall blow of a fin whale in the right conditions will hang in the air for several seconds, effectively doubling the detection window for observers at sea level. Although it was beyond the scope of the ASI surveys to quantify these differences, the probability of seeing a fin whale from a vessel may not be substantially lower than from an airplane. Thus, it appears the high disparity in the abundance estimates between the aerial and vessel surveys (1,684 (95% CI = 977-2,904) and 13,315 (95% CI = 6,798-26,082) respectively) may not relate to differences in perception bias, but rather the lower levels of coverage during the vessel surveys and the corresponding lower number of overall sightings (17 on track compared with 44 for the aerial surveys). Attempting density estimation with such a small sample size can often result in unreliable density estimates, as appears to be the case here.

Risso's dolphin

Sightings of Risso's dolphins were less numerous during the vessel surveys than the aerial one, making density estimation less robust. Overall, 8.9% of all aerial sightings with a species ID (including the 'striped or common' category) were Risso's dolphins versus only 3.5% of vessel sightings. While the body morphology and colouration make the species easily identifiable from both vessel and aerial platforms, minimising biases due to incomplete species identification, the well-known shy nature of this species, leading to avoidance behaviour towards approaching boats, could explain the relatively small number of sightings recorded during the vessel-based survey. This, alongside the well-known strong habitat preferences for the species and the temporal segregation in the use of slope areas reported for example between the Risso's dolphin and the sperm whale, could also account for the observed differences in the number of recorded sightings between the two surveys.

Deep-diving cetaceans

When comparing results between acoustic and visual surveys, the availability of deep-diving species such as sperm whales is extremely divergent. A correction factor of 0.872, for example, was applied to acoustic detection functions to allow for whales missed during periods without vocalisations. A correction of 0.173 has been used previously (Mannocci *et al.*, 2018b) to correct aerial sightings of sperm whales in the Mediterranean for periods when individuals were unavailable for detection at the surface (i.e., during deep dives). This stark difference in availability between the two techniques suggest that if the ASI sightings from the aerial surveys were corrected with appropriate values, the subsequent density estimates may be closer to those derived from the acoustic surveys. A crude application of a g(0) correction of 0.173, for example, to the abundance estimate derived from the aerial surveys (1,443) would derive a figure of 8,341, which is closer to the acoustic estimate of 4,599 individuals.

A trained regional taskforce

Among the main achievements of the ASI, the capacity building component developed in collaboration with the UNEP/MAP/SPA-RAC allowed to train in 2018 and 2019 more than 100 scientists from all the ACCOBAMS Area on cetacean and marine megafauna monitoring. The Capacity-building programme was developed to serve the preparation of the teams in charge of conducting the surveys and on the basis of the capacity building needs identified by each Riparian Country. In practice, two dedicated workshops were organised in Cuers, France, in May 2018 and in Samos, Greece, in June 2018 to train cruise leaders and the observers for both the aerial and vessel components of the survey, respectively. In addition, the ASI Capacity building programme continued to be implemented in 2019, in collaboration and with the support of the EcAp MED II project (Mediterranean Implementation of the Ecosystem Approach, in coherence with the European Union (EU) Marine Strategy Framework Directive (MSFD)) coordinated by the UNEP/MAP/SPA-RAC, through a series of 4 sub-regional workshops conducted to train national experts from the entire Mediterranean region on a range of monitoring techniques and software use.

In line with those key achievements, the analysis of the data was conceived to be as participatory and formative as possible, through the implementation of data analysis sub-regional workshops. The first one was organized at the end of 2019 for the central Mediterranean area, where a participatory approach to data analysis and interpretation, along with training sessions was implemented, with the participation of scientists from Albania, Croatia, Israel, Italy, Montenegro and Slovenia. Two additional analytical workshops were postponed due to the Covid-19 crisis and remain to be conducted for the Western Mediterranean basin and from the Eastern Mediterranean. The training in data analysis is important as it allow better appropriation and use of the data at national levels.

The intensive capacity building programme of the ASI served both to ensure the highest quality possible of data collection during the campaign, through pre-survey training of all aerial observers and national boat team leaders, and to strengthen the overall monitoring and analytical skills at regional level for a longer-term perspective. The ASI has built a solid foundation and a trained task force that can be mobilized again in the future. Any future survey conducted in the region will be able to draw on this pool of trained scientists. For future regional/subregional surveys in the coming years, it will be important to continue integrating/training new people, to ensure continuity and updating of ASI-trained observers' skills by providing pre-survey training to the field teams.

Perspectives for Conservation

The collected data and results can be used in a variety of ways to meet national and international requirements, such as those arising from the European Directives (Marine Strategy Framework Directive and Habitat Directive) and from the Ecosystem Approach under the framework of the Barcelona Convention (with the Integrated Monitoring and Assessment Programme). Data and results can be used at different scales, ranging from basin level to national level or more specific geographical borders. As an example, several countries have already requested abundance and density estimates to provide information on national waters. The data will be used to inform conservation measures and facilitate place-based conservation efforts in the area; they will be used to facilitate the Cetacean Critical Habitat (CCH) ongoing identification effort, as well as to improve and enhance the identification of Important Marine Mammal Areas (IMMAs), under the framework of the IUCN Task Force on Marine Mammals Protected Areas.

To address this key issue of turning the ASI survey effort into conservation outcomes, a major goal of the ACCOBAMS Survey Initiative is the development of conservation recommendations, through organizing a regional workshop based on the interpretation of the ASI large scale survey results. This event is under preparation in collaboration with the ACCOBAMS Scientific Committee and the recommendations that will emerge from it will then be presented for discussion at the next ACCOBAMS Meeting of Parties (MOP8) in 2022, and with other relevant stakeholders.

A special issue of a peer reviewed journal which will present a set of papers reporting the results of the ASI is under preparation, thus enabling the scientific community at large to become aware and benefit from these outcomes, which in the same vein will be presented at national and international conferences.

As a direct outcome of the ASI project, the ASI results are simultaneously being used to update the ACCOBAMS reference publication on the Cetacean Conservation Status which is expected in November 2021.

The collected data and results are also being used by local scientists to re-assess Mediterranean Sea cetacean status under the framework of the IUCN Red List, in collaboration with the IUCN Center for Mediterranean Cooperation (IUCN-Med). The available regional estimates will be used as baseline information to evaluate the population status of those species previously assessed and to provide new assessments for Data Deficient (DD) species. The ASI abundance and density estimates proved to be crucial in the recent assessments and allowed quantitative evaluations of the stock structure at the Mediterranean level.

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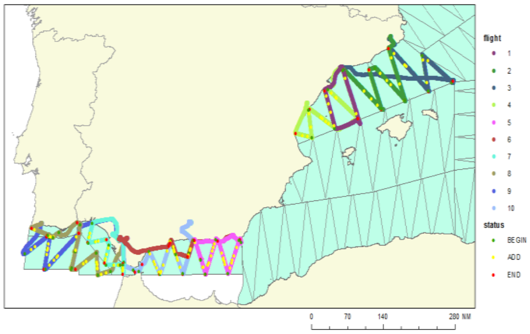
ANNEX I – PLANES TRACKS DETAILS

Tracks of the planes during dedicated flights covered by the different teams. Different colours represent different flights.



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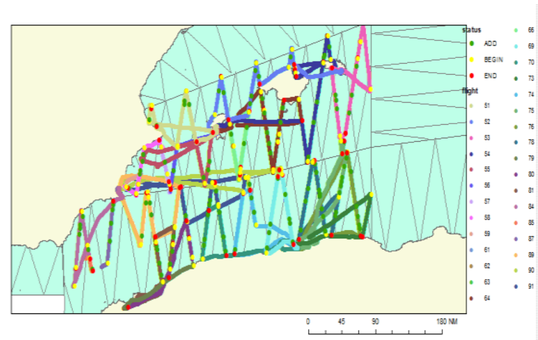

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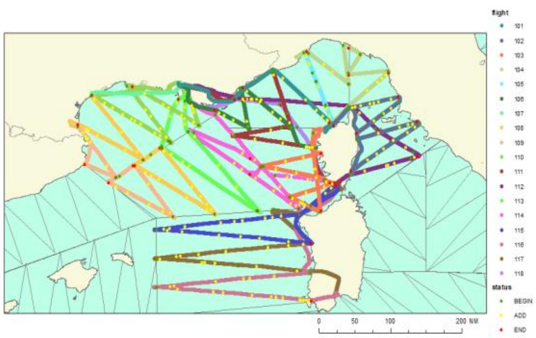

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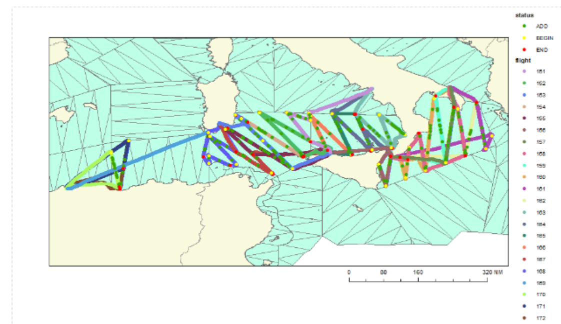

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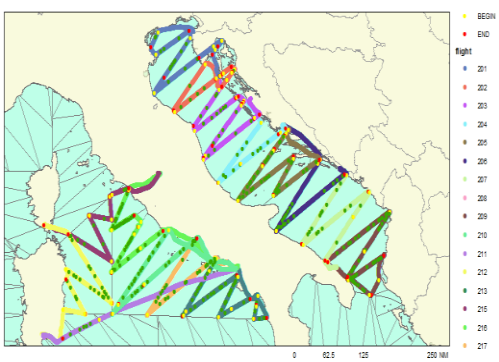

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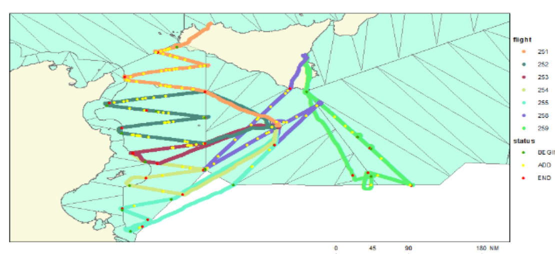

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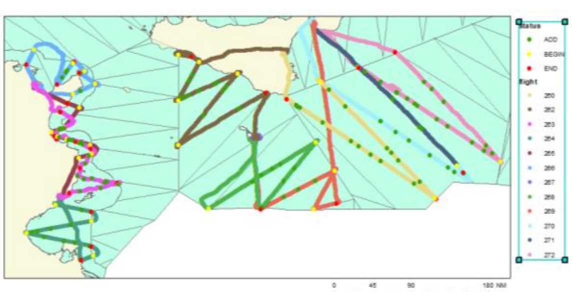

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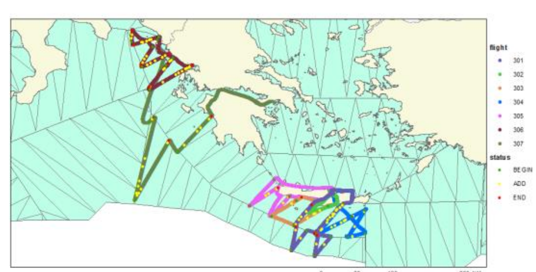

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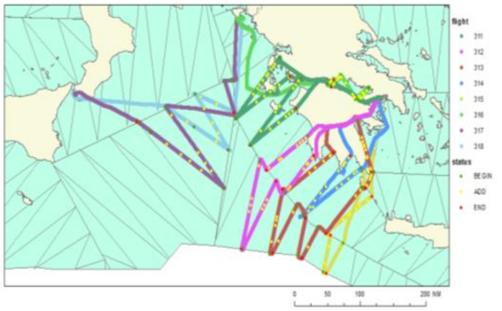

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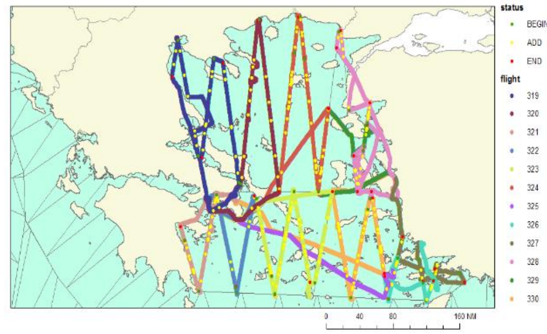
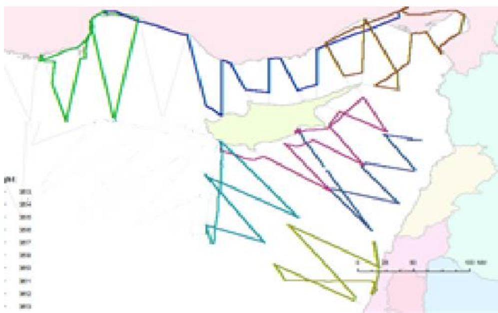
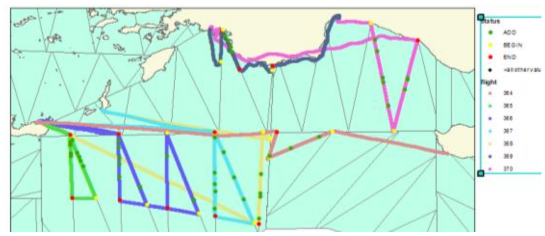


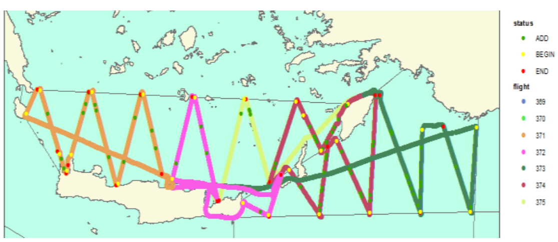
Team G3



Team H1



Team H2



Team H3

ANNEX II - SUPPLEMENTARY MATERIAL

The following figures (Fig 1-9) present the location of cetacean sightings; in some instances, cetaceans are grouped in larger categories, to allow for species uncertainties and include all the observations.

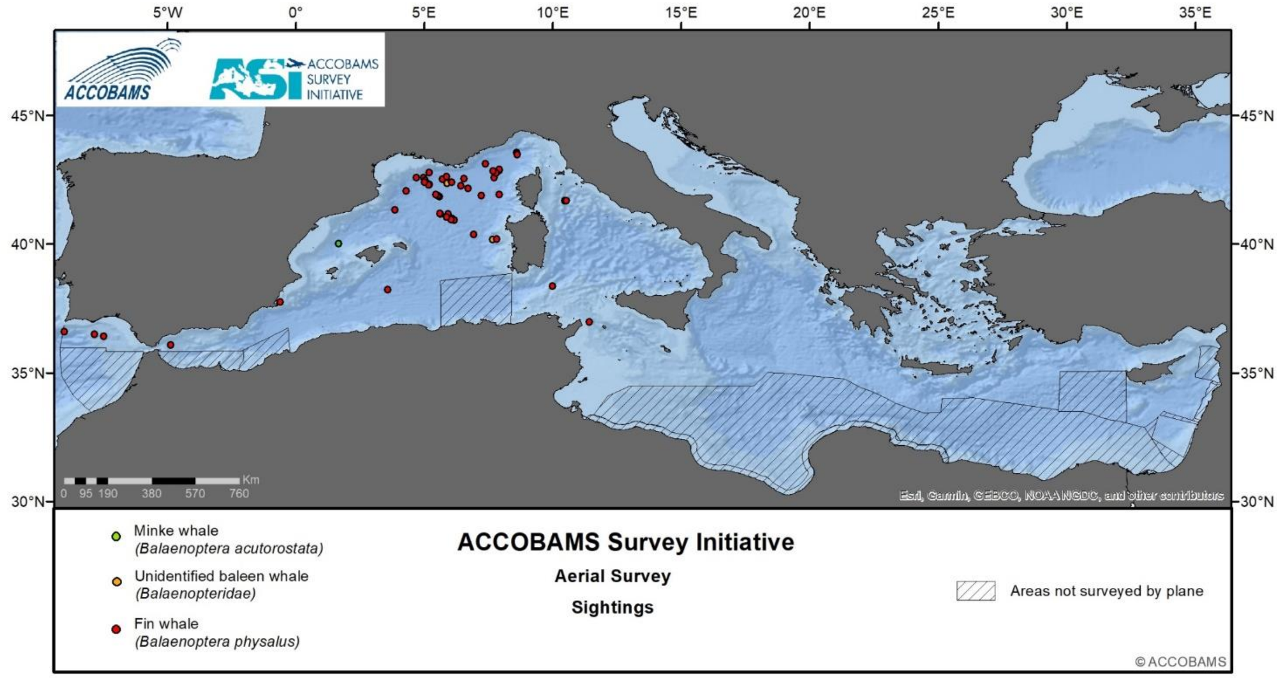


Figure 1. Baleen whale sightings.

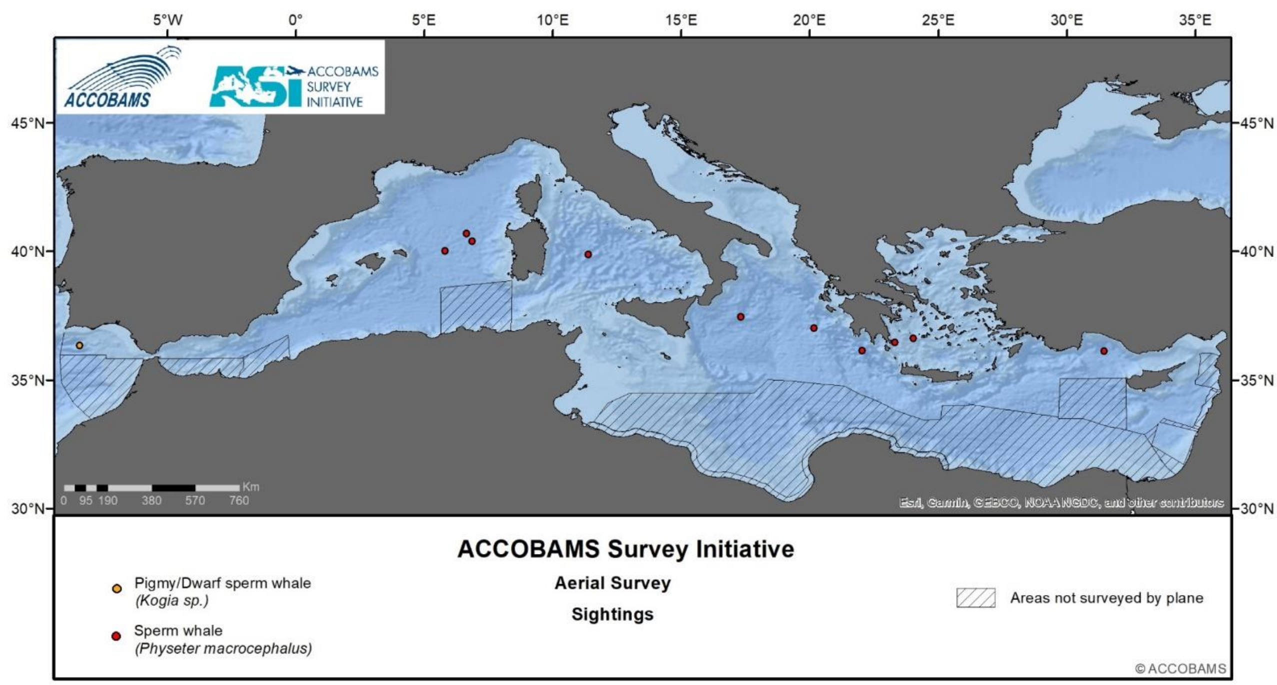


Figure 2. Sperm whale sightings.

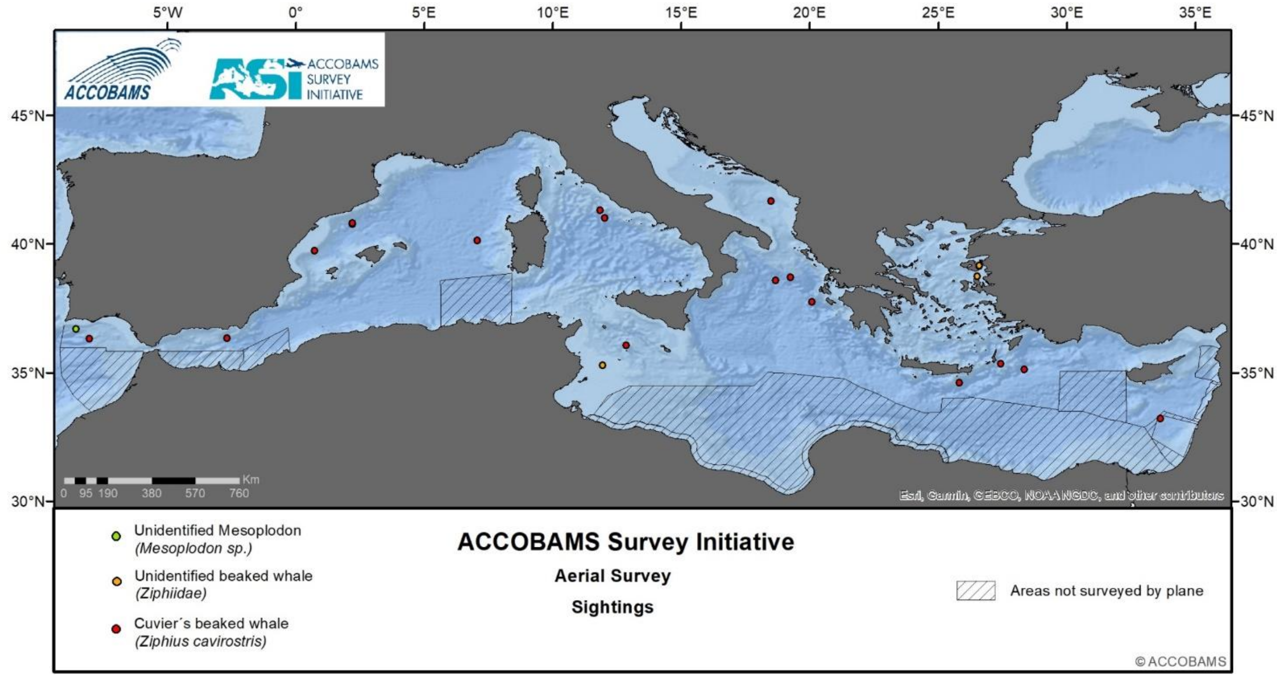


Figure 3. Beaked whale sightings.

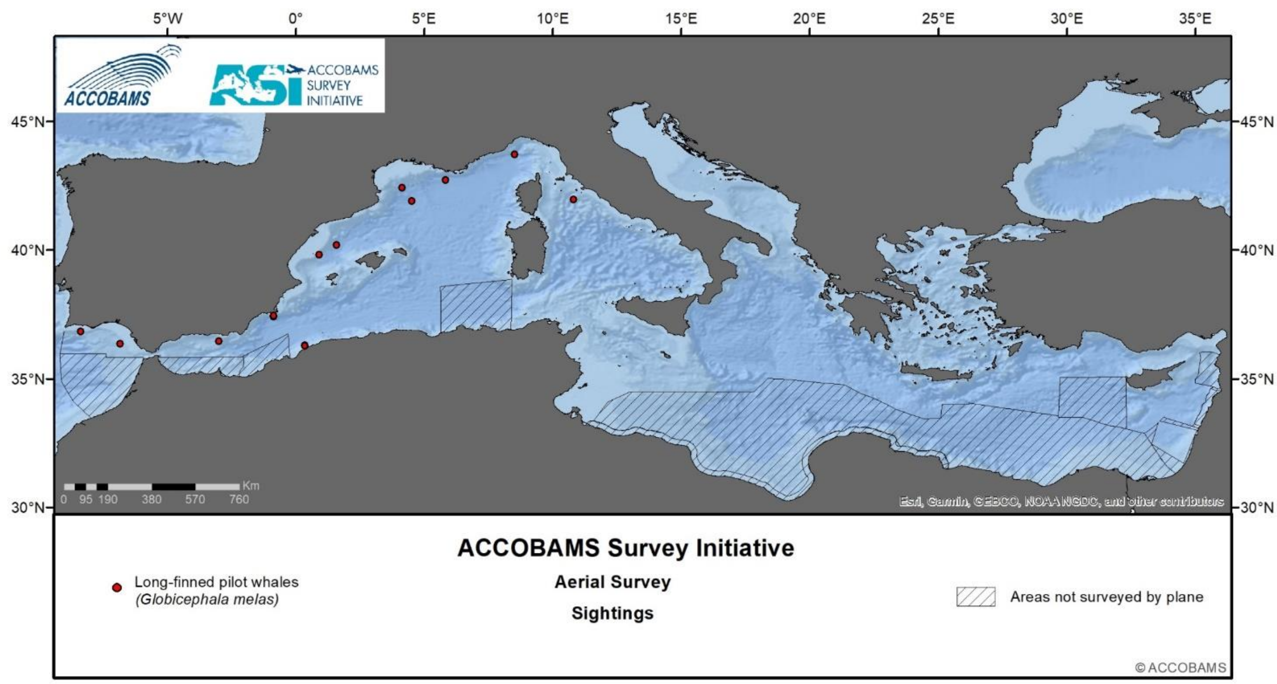


Figure 4. Long-finned pilot whale sightings.

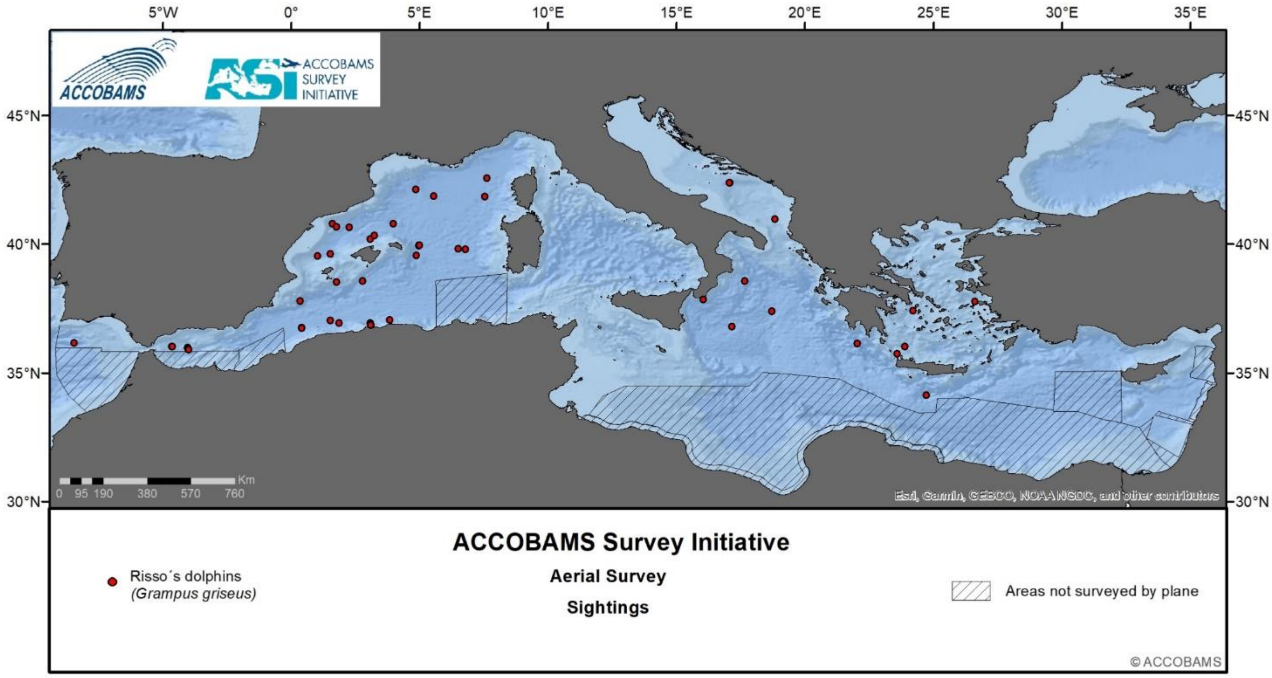


Figure 5. Risso’s dolphin sightings.

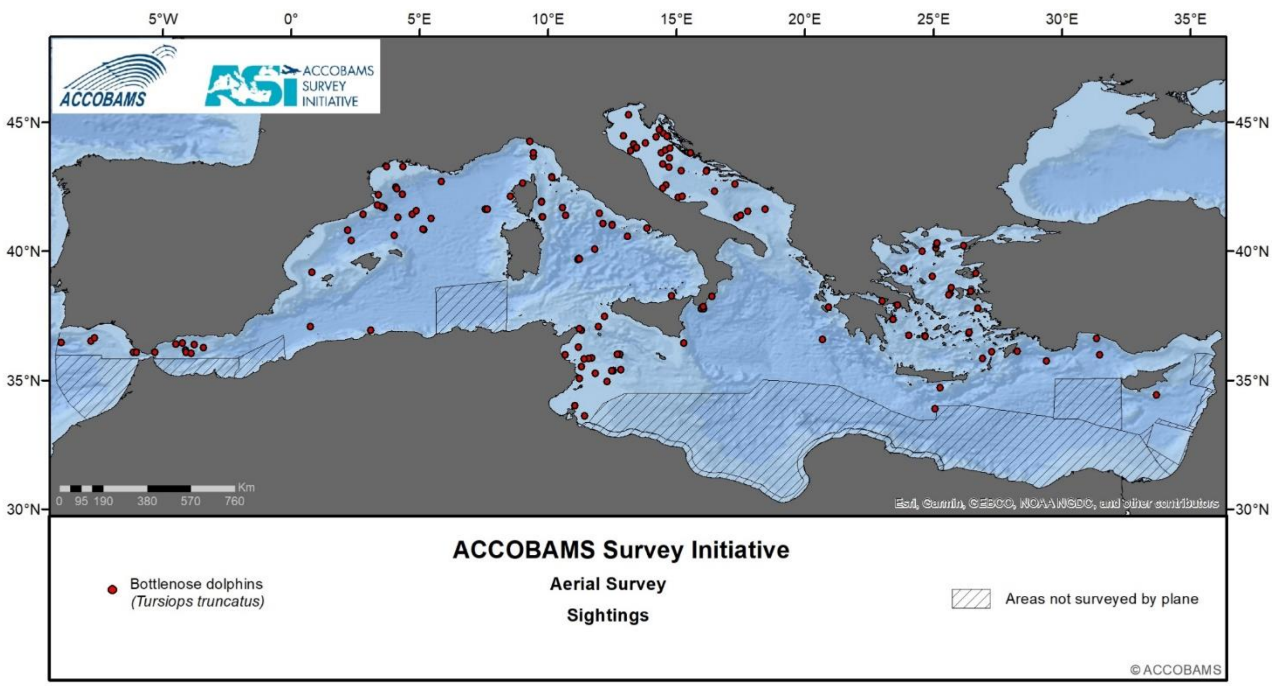


Figure 6. Bottlenose dolphin sightings.

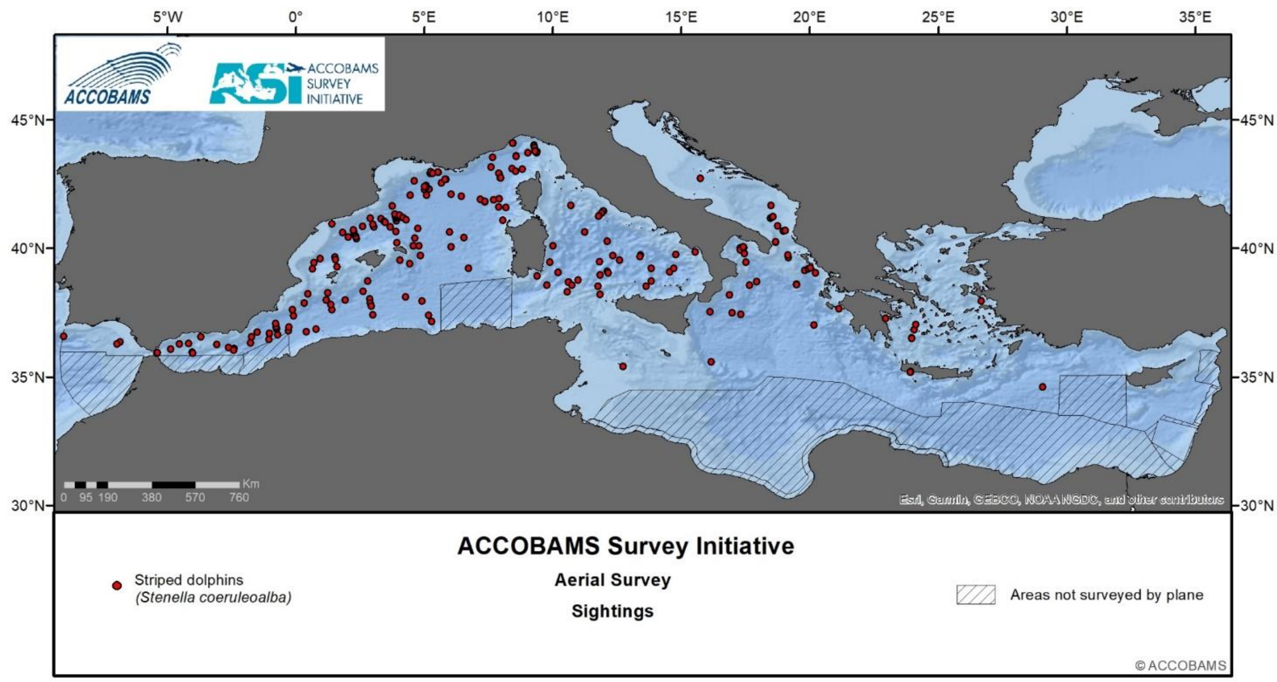


Figure 7. Striped dolphin sightings.

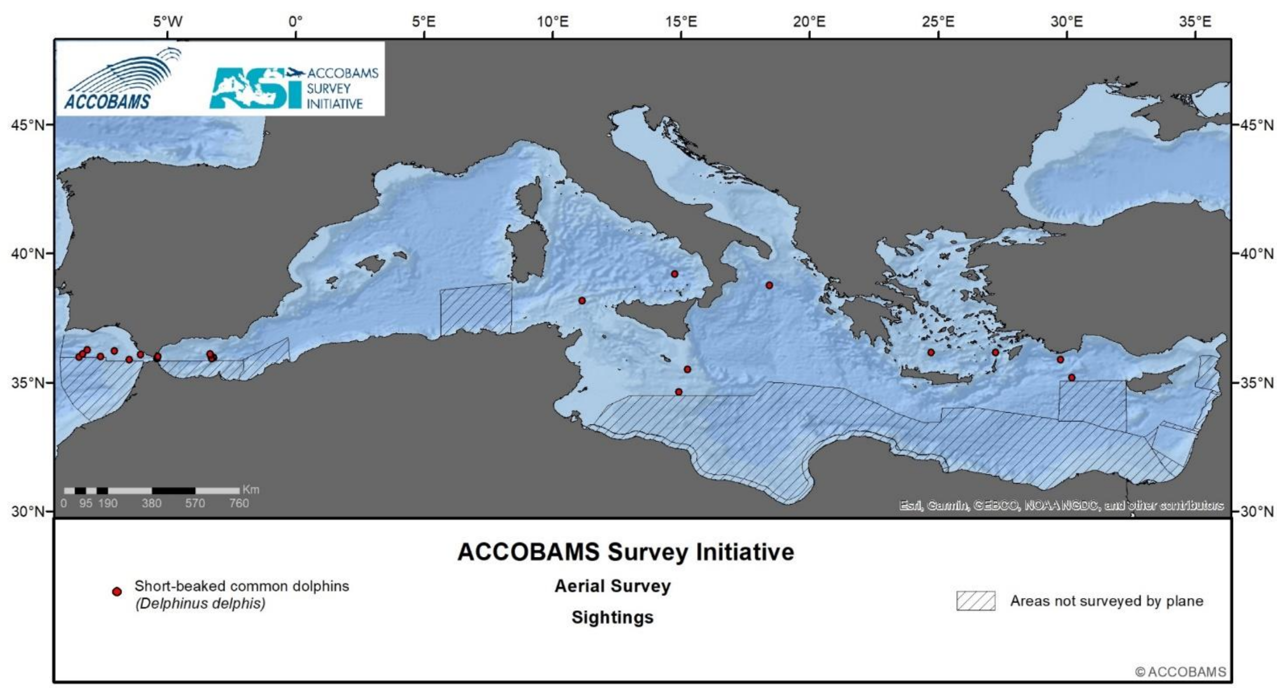


Figure 8. Common dolphin sightings.

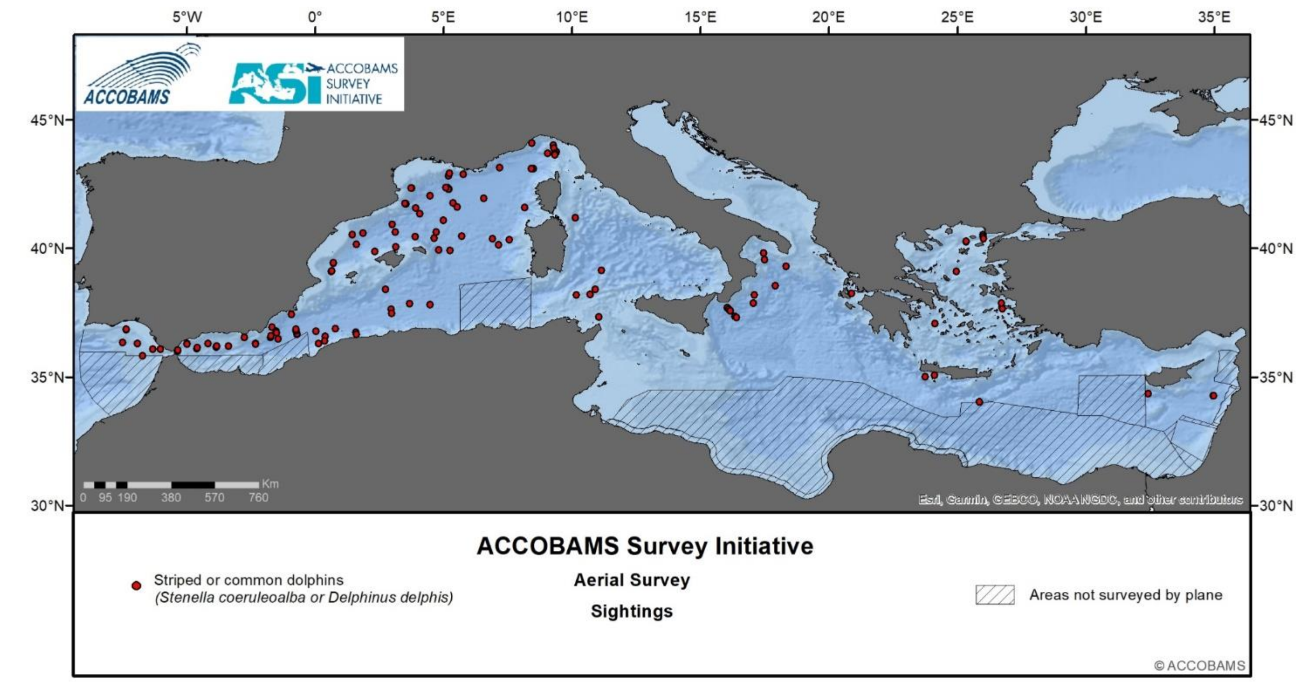


Figure 9. Striped or common dolphin sightings.

The following tables (Tabs. 1-11) present the results of the design-based analysis for each cetacean species. In these tables, mean group size is the arithmetic mean of the group size in each area or subarea; expected group size is the result of dividing the total estimated number of animals by the total estimated number of groups. The encounter rate of groups is the number of groups detected per every 100km of survey on effort in each area and subarea.

Tables 12 to 18 show the results of abundance estimates for the model-based analysis for each cetacean species or group. Table 19 shows a comparison of results between design and model-based analysis.

The information presented in these tables is the same as that presented for the design-based results, except the expected mean group size, that has not been included.

Table 20 presents the different blocks and sub-blocks with relevant geographic details

Table 1. Results of the design-based analysis for fin whales (including all fin whales and unidentified balaenopterids, except the minke whale).

Stratum	Area	n groups	mean group size	exp. group size	CV exp. group size	Effort (km)	Enc. Rate groups (x100km)	CV (%) Enc. rate groups	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33,720	2	1.50	1.50	0.3565	873	0.229	0.6316	0.0052	175	0.7632	45	672
Alboran	28,071	1	1.00	1.00	0.0000	765	0.131	1.0173	0.0020	55	1.0729	10	318
SWMed	279,415	4	1.25	1.13	0.1204	6,892	0.058	0.6141	0.0007	184	0.6238	59	567
NWMed	134,760	26	1.73	1.64	0.1434	4,471	0.581	0.2715	0.0078	1,048	0.3423	543	2,021
PelagosW	56,756	11	1.64	1.54	0.2833	2,261	0.486	0.3547	0.0045	254	0.3948	119	539
PelagosE	31,076	0	0.00	0.00	0.0000	1,036	0.000	0.0000	0.0000	0	0.0000	0	0
Tyrrhenian	231,298	3	1.67	2.20	0.6152	7,080	0.042	0.5721	0.0008	181	0.8727	41	793
SCMed	152,961	1	1.00	1.00	0.0000	4,583	0.022	1.0053	0.0001	10	1.0079	2	54
Adriatic	135,783	0	0.00	0.00	0.0000	3,816	0.000	0.0000	0.0000	0	0.0000	0	0
IonianC	185926	0	0.00	0.00	0.0000	5,302	0.000	0.0000	0.0000	0	0.0000	0	0
IonianE	172477	0	0.00	0.00	0.0000	5,186	0.000	0.0000	0.0000	0	0.0000	0	0
Aegean	191,150	0	0.00	0.00	0.0000	5,490	0.000	0.0000	0.0000	0	0.0000	0	0
NEMed	161,669	0	0.00	0.00	0.0000	3,446	0.000	0.0000	0.0000	0	0.0000	0	0
EMed	107,687	0	0.00	0.00	0.0000	2,833	0.000	0.0000	0.0000	0	0.0000	0	0
Total	**1,902,749**	**48**	**1.65**	**1.55**	**0.1187**	**54,035**	**0.089**	**0.1860**	**0.0010**	**1,906**	**0.2867**	**1,095**	**3,319**
Atlantic	33,720	2	1.50	1.50	0.2377	873	0.229	0.6316	0.0052	175	0.7632	45	672
MedW	499,002	42	1.64	1.53	0.0787	14,390	0.292	0.2040	0.0035	1,765	0.2797	1,028	3,031
MedC	601,262	4	1.50	2.07	0.2940	18,002	0.031	0.4989	0.0005	195	0.8281	47	806
Adriatic	135,783	0	0.00	0.00	0.0000	3,816	0.000	0.0000	0.0000	0	0.0000	0	0
MedE	632,983	0	0.00	0.00	0.0000	16,953	0.000	0.0000	0.0000	0	0.0000	0	0
Total	**1,902,749**	**48**	**1.65**	**1.56**	**0.0745**	**54,035**	**0.089**	**0.1860**	**0.0011**	**2,135**	**0.2802**	**1,241**	**3,673**

Table 2. Results of the design-based analysis for sperm whales (derived from the detection function of all whales pooled together).

Stratum	Area	n groups	mean group size	exp. group size	CV exp. group size	Effort (km)	Enc. Rate groups (x100km)	CV (%) Enc. rate groups	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33,720	0	0.00	0.00	0.0000	873	0.000	0.0000	0.0000	0	0.0000	0	0
Alboran	28,071	0	0.00	0.00	0.0000	765	0.000	0.0000	0.0000	0	0.0000	0	0
SWMed	279,415	5	1.60	1.54	0.1584	6,892	0.073	0.6626	0.0015	416	0.8240	101	1,716
NWMed	134,760	0	0.00	0.00	0.0000	4,471	0.000	0.0000	0.0000	0	0.0000	0	0
PelagosW	56,756	0	0.00	0.00	0.0000	2,261	0.000	0.0000	0.0000	0	0.0000	0	0
PelagosE	31,076	0	0.00	0.00	0.0000	1,036	0.000	0.0000	0.0000	0	0.0000	0	0
Tyrrhenian	231,298	1	1.00	1.00	0.0000	7,080	0.014	1.0014	0.0003	63	1.0596	12	348
SCMed	152,961	0	0.00	0.00	0.0000	4,583	0.000	0.0000	0.0000	0	0.0000	0	0
Adriatic	135,783	0	0.00	0.00	0.0000	3,816	0.000	0.0000	0.0000	0	0.0000	0	0
Ionian C	185,926	1	4.00	4.00	0.0000	5,302	0.019	1.0027	0.0015	272	1.0609	49	1,507
Ionian E	172,477	1	1.00	1.00	0.0000	5,186	0.019	0.0000	0.0004	64	1.0544	12	353
Aegean	191,150	1	7.00	7.00	0.0000	5,490	0.018	0.9832	0.0025	472	1.0425	87	2,552
NEMed	161,669	1	3.00	3.00	0.0000	3,446	0.021	0.9994	0.0012	195	1.0577	35	1,080
EMed	107,687	0	0.00	0.00	0.0000	2,833	0.000	0.0000	0.0000	0	0.0000	0	0
Total	**1,902,749**	**10**	**3.00**	**2.48**	**0.6768**	**54,035**	**0.022**	**0.3722**	**0.0008**	**1,478**	**0.5175**	**568**	**3,849**
Atlantic	33,720	0	0.00	0.00	0.0000	873	0.000	0.0000	0.0000	0	0.0000	0	0
MedW	499,002	5	1.60	1.54	0.1031	14,390	0.035	0.6632	0.0007	356	0.8245	87	1,465
MedC	601,262	2	2.50	2.50	0.4245	18,002	0.011	0.7074	0.0005	324	0.8946	72	1,458
Adriatic	135,783	0	0.00	0.00	0.0000	3,816	0.000	0.0000	0.0000	0	0.0000	0	0
MedE	632,983	3	3.67	3.67	0.3930	16,953	0.016	0.5730	0.0012	737	0.7751	192	2,832
Total	**1,902,749**	**10**	**3.00**	**2.52**	**0.2791**	**54,035**	**0.019**	**0.3722**	**0.0007**	**1,416**	**0.5251**	**537**	**3,733**

Table 3. Results of the design-based analysis for Risso´s dolphins.

Stratum	Area	n groups	mean group size	exp. group size	CV exp. group size	Effort (km)	Enc. Rate groups (x100km)	CV (%) Enc. rate groups	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33,720	1	15.00	15.00	0.0000	873	0.115	0.9763	0.0279	942	0.9888	181	4,906
Alboran	28,071	8	1.13	1.11	0.0534	765	1.046	0.7829	0.0212	595	0.7655	153	2,317
SWMed	279,415	27	6.48	6.66	1.6668	6,892	0.392	0.3473	0.0561	15,682	0.4141	7,170	34,302
NWMed	134,760	7	6.00	6.00	1.6720	4,471	0.157	0.4125	0.0153	2,058	0.5524	743	5,701
PelagosW	56,756	2	2.00	2.19	0.6930	2,261	0.088	0.7068	0.0039	223	0.8565	51	971
PelagosE	31,076	0	0.00	0.00	0.0000	1,036	0.000	0.0000	0.0000	0	0.0000	0	0
Tyrrhenian	231,298	0	0.00	0.00	0.0000	7,080	0.000	0.0000	0.0000	0	0.0000	0	0
SCMed	152,961	0	0.00	0.00	0.0000	4,583	0.000	0.0000	0.0000	0	0.0000	0	0
Adriatic	135,783	3	7.00	6.39	2.0297	3,816	0.079	0.7262	0.0108	1,467	0.7054	419	5,130
Ionian C	185,926	5	4.80	5.17	1.8040	5,302	0.094	0.5292	0.0087	1,617	0.5902	549	4,756
Ionian E	172,477	2	21.00	17.30	13.1205	5,186	0.039	0.0000	0.0135	2,323	0.9480	480	11,248
Aegean	191,150	3	6.00	5.58	1.3883	5,490	0.055	0.5653	0.0058	1,101	0.5946	373	3,251
NEMed	161,669	0	0.00	0.00	0.0000	3,446	0.000	0.0000	0.0000	0	0.0000	0	0
EMed	107,687	0	0.00	0.00	0.0000	2,833	0.000	0.0000	0.0000	0	0.0000	0	0
Total	**1,902,749**	**58**	**5.92**	**6.09**	**1.1252**	**54,035**	**0.107**	**0.2121**	**0.0137**	**26,006**	**0.2910**	**14,851**	**45,540**
Atlantic	33,720	1	15.00	15.00	0.0000	873	0.115	0.9763	0.0279	942	0.9888	181	4,906
MedW	499,002	44	5.23	5.45	0.2214	14,390	0.306	0.2673	0.0334	16,651	0.3497	8,545	32,448
MedC	601,262	5	4.80	5.17	0.3480	18,002	0.028	0.5284	0.0026	1,540	0.5897	527	4,499
Adriatic	135,783	3	7.00	6.39	0.3177	3,816	0.079	0.7262	0.0108	1,467	0.7054	419	5,130
MedE	632,983	5	12.00	10.46	0.5554	16,953	0.027	0.4444	0.0055	3,506	0.6833	1,040	11,819
Total	**1,902,749**	**58**	**5.92**	**6.06**	**0.1817**	**54,035**	**0.107**	**0.2121**	**0.0127**	**24,106**	**0.2827**	**13,986**	**41,548**

Table 4. Results of the design-based analysis for bottlenose dolphins.

Stratum	Area	n groups	mean group size	exp. group size	CV exp. group size	Effort (km)	Enc. Rate groups (x100km)	CV (%) Enc. rate groups	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33,720	7	6.57	6.57	1.1414	873	0.802	0.5603	0.1037	3,495	0.6763	1,025	11,925
Alboran	28,071	11	12.36	12.36	2.6712	765	1.438	0.3810	0.3499	9,821	0.4977	3,829	25,190
SWMed	279,415	3	3.33	3.15	0.1620	6,892	0.044	0.5734	0.0021	590	0.6054	197	1,773
NWMed	134,760	25	7.16	7.16	1.2675	4,471	0.559	0.3356	0.0788	10,615	0.4090	4,881	23,086
PelagosW	56,756	3	6.67	6.67	3.4300	2,261	0.133	0.5754	0.0174	988	0.7797	251	3,886
PelagosE	31,076	7	4.00	4.00	1.0009	1,036	0.676	0.5914	0.0391	1,217	0.5987	400	3,697
Tyrrhenian	231,298	14	5.14	5.14	1.1311	7,080	0.198	0.3077	0.0200	4,628	0.3830	2,237	9,576
SCMed	152,961	20	6.60	6.60	2.7322	4,583	0.436	0.3080	0.0567	8,668	0.5084	3,368	22,308
Adriatic	135,783	32	4.75	4.90	0.8841	3,816	0.838	0.1876	0.0762	10,350	0.2916	5,896	18,166
Ionian C	185,926	5	3.80	3.80	0.4092	5,302	0.094	0.6001	0.0071	1,311	0.5928	444	3,874
Ionian E	172,477	5	5.80	5.80	0.8690	5,186	0.096	0.0000	0.0110	1,898	0.4795	775	4,650
Aegean	191,150	19	7.00	7.10	1.3985	5,490	0.346	0.2594	0.0472	9,017	0.3728	4,435	18,336
NEMed	161,669	5	2.00	2.00	0.6951	3,446	0.104	0.4409	0.0041	661	0.5690	232	1,882
EMed	107,687	1	1.00	1.00	0.0000	2,833	0.035	0.9898	0.0007	75	0.9934	14	390
Total	**1,902,749**	**157**	**6.69**	**6.26**	**0.6037**	**54,035**	**0.291**	**0.1221**	**0.0333**	**63,333**	**0.1716**	**45,331**	**88,484**
Atlantic	33,720	7	6.57	6.57	0.1737	873	0.802	0.5603	0.1037	3,495	0.6763	1,025	11,925
MedW	499,002	42	8.21	8.28	0.1479	14,390	0.292	0.2374	0.0468	23,363	0.3053	13,001	41,984
MedC	601,262	46	5.46	5.52	0.2360	18,002	0.256	0.2014	0.0266	16,010	0.3138	8,773	29,215
Adriatic	135,783	32	4.75	4.90	0.1803	3,816	0.838	0.1876	0.0762	10,350	0.2916	5,896	18,166
MedE	632,983	30	5.77	5.81	0.1756	16,953	0.164	0.2013	0.0184	11,669	0.3066	6,479	21,016
Total	**1,902,749**	**157**	**6.69**	**6.25**	**0.0943**	**54,035**	**0.291**	**0.1221**	**0.0341**	**64,886**	**0.1725**	**46,377**	**90,782**

Table 5. Results of the design-based analysis for long-finned pilot whales (derived from the detection function for "large dolphins").

Stratum	Area	n groups	mean group size	exp. group size	CV exp. group size	Effort (km)	Enc. Rate groups (x100km)	CV (%) Enc. rate groups	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33,720	2	0.50	3.64	0.3323	873	0.229	0.7020	0.0130	439	0.7542	115	1,678
Alboran	28,071	1	0.00	3.00	0.0000	765	0.131	1.0112	0.0071	198	1.0132	37	1,069
SWMed	279,415	6	1.69	6.41	1.7843	6,892	0.087	0.6988	0.0090	2,510	0.6264	809	7,787
NWMed	134,760	3	9.17	11.67	7.5152	4,471	0.067	0.5648	0.0141	1,900	0.8613	436	8,287
PelagosW	56,756	1	0.00	5.00	0.0000	2,261	0.044	1.0080	0.0040	226	1.0101	43	1,197
PelagosE	31,076	1	0.00	4.00	0.0000	1,036	0.097	0.9960	0.0086	267	1.0031	50	1,434
Tyrrhenian	231,298	0	0.00	0.00	0.0000	7,080	0.000	0.0000	0.0000	0	0.0000	0	0
SCMed	152,961	0	0.00	0.00	0.0000	4,583	0.000	0.0000	0.0000	0	0.0000	0	0
Adriatic	135,783	0	0.00	0.00	0.0000	3,816	0.000	0.0000	0.0000	0	0.0000	0	0
Ionian C	185,926	0	0.00	0.00	0.0000	5,302	0.000	0.0000	0.0000	0	0.0000	0	0
Ionian E	172,477	0	0.00	0.00	0.0000	5,186	0.000	0.0000	0.0000	0	0.0000	0	0
Aegean	191,150	0	0.00	0.00	0.0000	5,490	0.000	0.0000	0.0000	0	0.0000	0	0
NEMed	161,669	0	0.00	0.00	0.0000	3,446	0.000	0.0000	0.0000	0	0.0000	0	0
EMed	107,687	0	0.00	0.00	0.0000	2,833	0.000	0.0000	0.0000	0	0.0000	0	0
Total	**1,902,749**	**14**	**1.88**	**6.49**	**1.8084**	**54,035**	**0.026**	**0.3452**	**0.0029**	**5,540**	**0.4228**	**2,497**	**12,295**
Atlantic	33,720	2	3.50	3.64	0.0912	873	0.229	0.7020	0.0130	439	0.7542	115	1,678
MedW	499,002	11	7.73	7.46	0.3534	14,390	0.076	0.4309	0.0097	4,833	0.4859	1,957	11,938
MedC	601,262	1	4.00	4.00	0.0000	18,002	0.006	1.0001	0.0005	297	1.0071	58	1,537
Adriatic	135,783	0	0.00	0.00	0.0000	3,816	0.000	0.0000	0.0000	0	0.0000	0	0
MedE	632,983	0	0.00	0.00	0.0000	16,953	0.000	0.0000	0.0000	0	0.0000	0	0
Total	**1,902,749**	**14**	**6.47**	**6.61**	**0.3021**	**54,035**	**0.026**	**0.3452**	**0.0029**	**5,569**	**0.4304**	**2,479**	**12,513**

Table 6. Results of the design-based analysis for small dolphins (striped, common and unidentified dolphins pooled together).

Stratum	Area	n groups	mean group size	exp. group size	CV exp. group size	Effort (km)	Enc. Rate groups (x100km)	CV (%) Enc. rate groups	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33,720	31	19.58	19.58	5.4569	873	3.550	0.3172	1.4707	49,591	0.4083	22,622	108,711
Alboran	28,071	46	36.20	36.20	8.7257	765	6.014	0.2995	4.6053	129,274	0.4725	52,601	317,711
SWMed	279,415	120	22.54	22.24	3.5228	6,892	1.741	0.1535	0.9707	271,220	0.2132	179,150	410,608
NWMed	134,760	107	17.77	17.88	2.7641	4,471	2.393	0.1833	0.8785	118,386	0.2011	79,883	175,446
PelagosW	56,756	48	16.29	16.09	4.6782	2,261	2.123	0.2755	0.6674	37,881	0.3357	19,796	72,488
PelagosE	31,076	4	3.25	3.25	0.0000	1,036	0.386	0.9835	0.0238	740	0.9860	141	3,895
Tyrrhenian	231,298	54	15.67	15.98	2.5293	7,080	0.763	0.1694	0.1808	41,822	0.2245	27,054	64,652
SCMed	152,961	6	5.50	4.74	2.1477	4,583	0.131	0.4481	0.0102	1,558	0.6798	463	5,240
Adriatic	135,783	10	15.60	15.60	6.8596	3,816	0.262	0.4238	0.0544	7,380	0.5385	2,731	19,943
Ionian C	185,926	27	14.00	13.90	2.5142	5,302	0.509	0.2610	0.1381	25,676	0.3512	13,105	50,305
Ionian E	172,477	22	11.95	11.95	4.2193	5,186	0.424	0.0000	0.1308	22,555	0.4659	9,422	53,994
Aegean	191,150	19	16.42	16.45	2.6614	5,490	0.346	0.2987	0.1095	20,936	0.3468	10,787	40,633
NEMed	161,669	7	9.14	9.02	3.2423	3,446	0.146	0.3678	0.0189	3,055	0.6512	949	9,839
EMed	107,687	0	0.00	0.00	0.0000	2,833	0.000	0.0000	0.0000	0	0.0000	0	0
Total	**1,902,749**	**501**	**19.28**	**20.13**	**1.8617**	**54,035**	**0.927**	**0.0843**	**0.3837**	**730,074**	**0.1284**	**567,565**	**939,113**
Atlantic	33,720	31	19.58	19.58	0.2787	873	3.550	0.3172	1.4707	49,591	0.4083	22,622	108,711
MedW	499,002	321	21.97	21.99	0.1116	14,390	2.231	0.1036	1.0876	542,701	0.1535	402,168	732,344
MedC	601,262	91	13.96	13.87	0.1264	18,002	0.506	0.1383	0.1158	69,599	0.1952	47,622	101,718
Adriatic	135,783	10	15.60	15.60	0.4397	3,816	0.262	0.4238	0.0544	7,380	0.5385	2,731	19,943
MedE	632,983	48	13.31	13.26	0.1930	16,953	0.262	0.1865	0.0748	47,352	0.2808	27,572	81,323
Total	**1,902,749**	**501**	**19.28**	**19.76**	**0.0894**	**54,035**	**0.927**	**0.0843**	**0.3766**	**716,624**	**0.1236**	**562,802**	**912,488**

Table 7. Results of the design-based analysis for “striped or common dolphin” (unidentified dolphins labeled as either common or striped dolphins).

Stratum	Area	n groups	mean group size	exp. group size	CV exp. group size	Effort (km)	Enc. Rate groups (x100km)	CV (%) Enc. rate groups	Density (Anim./ km²)	Abundance	CV	95% Confidence Interval	
Atlantic	33,720	8	10.25	10.25	5.5496	873	0.916	0.4071	0.1987	6,699	0.6194	2,143	20,941
Alboran	28,071	20	44.70	44.70	17.6152	765	2.615	0.3611	2.4727	69,412	0.6199	22,138	217,634
SWMed	279,415	45	15.69	17.53	6.0128	6,892	0.653	0.2016	0.2909	81,284	0.4153	37,084	178,168
NWMed	134,760	38	13.11	13.07	3.2107	4,471	0.850	0.4137	0.2180	29,382	0.3205	15,840	54,500
PelagosW	56,756	12	10.58	10.66	3.7762	2,261	0.531	0.4208	0.1116	6,333	0.4572	2,665	15,051
PelagosE	31,076	2	3.00	3.00	0.0000	1,036	0.193	0.9835	0.0110	342	0.9860	65	1,798
Tyrrhenian	231,298	6	17.00	18.36	7.6463	7,080	0.085	0.3984	0.0257	5,934	0.6053	1,978	17,798
SCMed	152,961	0	0.00	0.00	0.0000	4,583	0.000	0.0000	0.0000	0	0.0000	0	0
Adriatic	135,783	0	0.00	0.00	0.0000	3,816	0.000	0.0000	0.0000	0	0.0000	0	0
Ionian C	185,926	6	10.50	10.50	4.7452	5,302	0.113	0.3999	0.0234	4,349	0.6199	1,411	13,404
Ionian E	172,477	4	3.00	3.00	1.1751	5,186	0.077	0.0000	0.0060	1,029	0.6398	325	3,263
Aegean	191,150	7	17.43	17.43	5.8402	5,490	0.128	0.4225	0.0422	8,064	0.4660	3,370	19,293
NEMed	161,669	0	0.00	0.00	0.0000	3,446	0.000	0.0000	0.0000	0	0.0000	0	0
EMed	107,687	0	0.00	0.00	0.0000	2,833	0.000	0.0000	0.0000	0	0.0000	0	0
Total	**1,902,749**	**148**	**17.50**	**18.76**	**4.1294**	**54,035**	**0.274**	**0.1469**	**0.1119**	**212,828**	**0.2638**	**127,483**	**355,307**
Atlantic	33,720	8	10.25	10.25	0.5414	873	0.916	0.4071	0.1987	6,699	0.6194	2,143	20,941
MedW	499,002	115	19.35	20.10	0.2395	14,390	0.799	0.1760	0.3561	177,674	0.2859	102,456	308,112
MedC	601,262	14	12.21	12.43	0.3319	18,002	0.078	0.2809	0.0176	10,590	0.4320	4,702	23,848
Adriatic	135,783	0	0.00	0.00	0.0000	3,816	0.000	0.0000	0.0000	0	0.0000	0	0
MedE	632,983	11	12.18	11.12	0.3361	16,953	0.060	0.3268	0.0143	9,072	0.4224	4,095	20,097
Total	**1,902,749**	**148**	**17.50**	**18.28**	**0.2109**	**54,035**	**0.274**	**0.1469**	**0.1072**	**204,035**	**0.2518**	**125,379**	**332,035**

Table 8. Results of the design-based analysis for striped dolphins.

Stratum	Area	n groups	mean group size	exp. group size	CV exp. group size	Effort (km)	Enc. Rate groups (x100km)	CV (%) Enc. rate groups	Density (Anim./ km²)	Abundance	CV	95% Confidence Interval	
Atlantic	33,720	6	10.00	10.00	0.0000	873	0.687	0.9812	0.1859	6,268	0.9836	1,209	32,497
Alboran	28,071	15	29.20	26.83	7.7445	765	1.961	0.3593	1.3483	37,848	0.4935	14,850	96,465
SWMed	279,415	61	28.66	28.51	5.3576	6,892	0.885	0.1947	0.5872	164,079	0.2443	102,158	263,530
NWMed	134,760	52	23.33	23.07	3.8973	4,471	1.163	0.2152	0.6410	86,386	0.2868	49,560	150,577
PelagosW	56,756	33	17.09	16.59	5.9631	2,261	1.459	0.2921	0.5137	29,154	0.4049	13,443	63,225
PelagosE	31,076	2	3.50	3.50	0.0000	1,036	0.193	0.9835	0.0127	394	0.9877	75	2,076
Tyrrhenian	231,298	37	17.95	18.24	3.2183	7,080	0.523	0.1922	0.1918	44,367	0.2339	28,183	69,844
SCMed	152,961	1	3.00	3.00	0.0000	4,583	0.022	0.9829	0.0013	199	0.9848	39	1,011
Adriatic	135,783	9	16.78	15.88	7.2658	3,816	0.236	0.4601	0.0756	10,264	0.5427	3,772	27,932
Ionian C	185,926	20	15.45	15.50	2.9285	5,302	0.377	0.3139	0.1147	21,325	0.3794	10,338	43,988
Ionian E	172,477	14	15.07	15.96	7.1135	5,186	0.270	0.0000	0.0961	16,582	0.6060	5,510	49,906
Aegean	191,150	6	18.00	17.08	3.2870	5,490	0.109	0.5164	0.0429	8,205	0.5810	2,840	23,706
NEMed	161,669	1	25.00	25.00	0.0000	3,446	0.021	0.9995	0.0103	1,673	1.0014	322	8,680
EMed	107,687	0	0.00	0.00	0.0000	2,833	0.000	0.0000	0.0000	0	0.0000	0	0
Total	**1,902,749**	**257**	**21.35**	**21.87**	**2.0926**	**54,035**	**0.476**	**0.0988**	**0.2243**	**426,744**	**0.1348**	**327,944**	**555,310**
Atlantic	33,720	6	10.00	10.00	0.0000	873	0.687	0.9812	0.1859	6,268	0.9836	1,209	32,497
MedW	499,002	161	24.61	24.31	0.1170	14,390	1.119	0.1230	0.6328	315,789	0.1641	229,306	434,888
MedC	601,262	60	16.38	16.62	0.1356	18,002	0.333	0.1639	0.1103	66,311	0.2037	44,639	98,505
Adriatic	135,783	9	16.78	15.88	0.4576	3,816	0.236	0.4601	0.0756	10,264	0.5427	3,772	27,932
MedE	632,983	21	16.38	16.67	0.2892	16,953	0.115	0.2891	0.0428	27,092	0.4272	12,128	60,519
Total	**1,902,749**	**257**	**21.35**	**21.41**	**0.0940**	**54,035**	**0.476**	**0.0988**	**0.2237**	**425,724**	**0.1324**	**328,694**	**551,397**

Table 9. Results of the design-based analysis for common dolphins (derived from the detection function of “small dolphins”).

Stratum	Area	n groups	mean group size	exp. group size	CV exp. group size	Effort (km)	Enc. Rate groups (x100km)	CV (%) Enc. rate groups	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33,720	13	33.23	33.23	9.6358	873	1.489	0.4692	1.0467	35,293	0.5412	12,809	97,245
Alboran	28,071	11	30.27	30.27	4.3299	765	1.438	0.5914	0.9211	25,855	0.6874	7,432	89,940
SWMed	279,415	0	0.00	0.00	0.0000	6,892	0.000	0.0000	0.0000	0	0.0000	0	0
NWMed	134,760	0	0.00	0.00	0.0000	4,471	0.000	0.0000	0.0000	0	0.0000	0	0
PelagosW	56,756	0	0.00	0.00	0.0000	2,261	0.000	0.0000	0.0000	0	0.0000	0	0
PelagosE	31,076	0	0.00	0.00	0.0000	1,036	0.000	0.0000	0.0000	0	0.0000	0	0
Tyrrhenian	231,298	1	12.00	12.00	0.0000	7,080	0.014	1.0033	0.0023	521	1.0088	100	2,707
SCMed	152,961	2	2.00	2.00	0.7089	4,583	0.044	0.6966	0.0019	286	0.8587	66	1,235
Adriatic	135,783	0	0.00	0.00	0.0000	3,816	0.000	0.0000	0.0000	0	0.0000	0	0
Ionian C	185,926	1	6.00	6.00	0.0000	5,302	0.019	0.9919	0.0022	414	0.9995	80	2,143
Ionian E	172,477	0	0.00	0.00	0.0000	5,186	0.000	0.0000	0.0000	0	0.0000	0	0
Aegean	191,150	2	18.50	18.50	8.1458	5,490	0.036	0.7077	0.0144	2,759	0.9089	600	12,687
NEMed	161,669	2	9.00	11.08	5.0655	3,446	0.042	0.6919	0.0076	1,230	0.9862	242	6,250
EMed	107,687	0	0.00	0.00	0.0000	2,833	0.000	0.0000	0.0000	0	0.0000	0	0
Total	**1,902,749**	**32**	**26.31**	**27.29**	**5.0409**	**54,035**	**0.059**	**0.2963**	**0.0349**	**66,359**	**0.3981**	**31,054**	**141,801**
Atlantic	33,720	13	33.23	33.23	0.2900	873	1.489	0.4692	1.0467	35,293	0.5412	12,809	97,245
MedW	499,002	11	30.27	30.27	0.1419	14,390	0.076	0.6106	0.0490	24,430	0.7028	7,039	84,792
MedC	601,262	4	5.50	4.79	0.3874	18,002	0.022	0.4968	0.0020	1,214	0.5848	419	3,519
Adriatic	135,783	0	0.00	0.00	0.0000	3,816	0.000	0.0000	0.0000	0	0.0000	0	0
MedE	632,983	4	13.75	15.27	0.3529	16,953	0.022	0.4971	0.0063	4,003	0.7319	1,107	14,471
Total	**1,902,749**	**32**	**26.31**	**27.24**	**0.1873**	**54,035**	**0.059**	**0.2963**	**0.0341**	**64,940**	**0.4005**	**30,350**	**138,953**

Table 10. Results of the design-based analysis for beaked whales (all species of beaked whales).

Stratum	Area	n groups	mean group size	exp. group size	CV exp. group size	Effort (km)	Enc. Rate groups (x100km)	CV (%) Enc. rate groups	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33,720	2	3.50	3.50	0.3565	873	0.229	0.6352	0.0148	498	0.6598	150	1,654
Alboran	28,071	1	4.00	4.00	0.0000	765	0.131	1.0064	0.0096	271	1.0196	50	1,467
SWMed	279,415	1	1.00	1.00	0.0000	6,892	0.015	0.9928	0.0003	75	1.0062	14	387
NWMed	134,760	3	5.67	5.67	1.2616	4,471	0.067	0.7327	0.0070	944	0.8433	222	4,019
PelagosW	56,756	0	0.00	0.00	0.0000	2,261	0.000	0.0000	0.0000	0	0.0000	0	0
PelagosE	31,076	0	0.00	0.00	0.0000	1,036	0.000	0.0000	0.0000	0	0.0000	0	0
Tyrrhenian	231,298	2	1.50	1.50	0.3540	7,080	0.028	0.7114	0.0008	181	0.7671	47	688
SCMed	152,961	2	2.00	2.00	0.7089	4,583	0.044	0.7002	0.0016	246	0.7996	62	984
Adriatic	135,783	1	1.00	1.00	0.0000	3,816	0.026	0.9986	0.0005	66	1.0120	13	343
Ionian C	185,926	2	2.00	2.00	0.0000	5,302	0.038	0.7105	0.0014	258	0.7292	71	938
Ionian E	172,477	2	2.00	2.00	0.0000	5,186	0.039	0.0000	0.0014	245	0.7256	68	883
Aegean	191,150	2	1.50	1.50	0.3542	5,490	0.036	0.7119	0.0010	193	0.7679	50	735
NEMed	161,669	0	0.00	0.00	0.0000	3,446	0.000	0.0000	0.0000	0	0.0000	0	0
EMed	107,687	1	6.00	6.00	0.0000	2,833	0.035	0.9655	0.0039	420	0.9793	82	2,155
Total	**1,902,749**	**19**	**2.75**	**2.81**	**0.4924**	**54,035**	**0.035**	**0.2331**	**0.0018**	**3,396**	**0.3496**	**1,740**	**6,631**
Atlantic	33,720	2	3.50	3.50	0.1019	873	0.229	0.6352	0.0148	498	0.6598	150	1,654
MedW	499,002	5	4.40	4.40	0.2903	14,390	0.035	0.5240	0.0028	1,406	0.6918	412	4,802
MedC	601,262	6	1.83	1.83	0.1531	18,002	0.033	0.4081	0.0011	677	0.4650	284	1,615
Adriatic	135,783	1	1.00	1.00	0.0000	3,816	0.026	0.9986	0.0005	66	1.0120	13	343
MedE	632,983	5	2.60	2.60	0.3001	16,953	0.027	0.4452	0.0013	828	0.5580	298	2,301
Total	**1,902,749**	**19**	**2.75**	**2.86**	**0.1856**	**54,035**	**0.035**	**0.2331**	**0.0018**	**3,475**	**0.3645**	**1,735**	**6,960**

Table 11. Results of the design-based analysis for Cuvier´s beaked whales (derived from the detection function of beaked whales).

Stratum	**Area**	**n groups**	**mean group size**	**exp. group size**	**CV exp. group size**	**Effort (km)**	**Enc. Rate groups (x100km)**	**CV (%) Enc. rate groups**	**Density (Anim./ km^2)**	**Abundance**	**CV**	**95% Confidence Interval**	
Atlantic	33,720	1	4.00	4.00	0.0000	873	0.115	0.9354	0.0084	285	0.9496	57	1,413
Alboran	28,071	1	4.00	4.00	0.0000	765	0.131	1.0064	0.0096	271	1.0196	50	1,467
SWMed	279,415	1	1.00	1.00	0.0000	6,892	0.015	0.9928	0.0003	75	1.0062	14	387
NWMed	134,760	3	5.67	5.67	1.2616	4,471	0.067	0.7327	0.0070	944	0.8433	222	4,019
PelagosW	56,756	0	0.00	0.00	0.0000	2,261	0.000	0.0000	0.0000	0	0.0000	0	0
PelagosE	31,076	0	0.00	0.00	0.0000	1,036	0.000	0.0000	0.0000	0	0.0000	0	0
Tyrrhenian	231,298	2	1.50	1.50	0.3540	7,080	0.028	0.7114	0.0008	181	0.7671	47	688
SCMed	152,961	1	3.00	3.00	0.0000	4,583	0.022	0.9931	0.0012	185	1.0065	35	960
Adriatic	135,783	1	1.00	1.00	0.0000	3,816	0.026	0.9986	0.0005	66	1.0120	13	343
Ionian C	185,926	2	2.00	2.00	0.0000	5,302	0.038	0.7105	0.0014	258	0.7292	71	938
Ionian E	172,477	2	2.00	2.00	0.0000	5,186	0.039	0.0000	0.0014	245	0.7256	68	883
Aegean	191,150	0	0.00	0.00	0.0000	5,490	0.000	0.0000	0.0000	0	0.0000	0	0
NEMed	161,669	0	0.00	0.00	0.0000	3,446	0.000	0.0000	0.0000	0	0.0000	0	0
EMed	107,687	1	6.00	6.00	0.0000	2,833	0.035	0.9655	0.0039	420	0.9793	82	2,155
Total	**1,902,749**	**15**	**3.13**	**3.08**	**0.5877**	**54,035**	**0.028**	**0.2731**	**0.0015**	**2,929**	**0.3856**	**1,407**	**6,096**
Atlantic	33,720	1	4.00	4.00	0.0000	873	0.115	0.9354	0.0084	285	0.9496	57	1,413
MedW	499,002	5	4.40	4.40	0.2903	14,390	0.035	0.5240	0.0028	1,406	0.6918	412	4,802
MedC	601,262	5	2.00	2.00	0.1415	18,002	0.028	0.4474	0.0010	616	0.4963	245	1,547
Adriatic	135,783	1	1.00	1.00	0.0000	3,816	0.026	0.9986	0.0005	66	1.0120	13	343
MedE	632,983	3	3.33	3.33	0.3268	16,953	0.016	0.5736	0.0010	637	0.6777	190	2,129
Total	**1,902,749**	**15**	**3.13**	**3.15**	**0.2000**	**54,035**	**0.028**	**0.2731**	**0.0016**	**3,009**	**0.4029**	**1,404**	**6,448**

Table 12. Results of the model-based analysis for fin whales (without including unidentified balaenopterids and minke whale).

Stratum	Area	n groups	mean group size	CV mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33,779	2	1.50	0.33	907	0.221	0.0022	75	0.6670	34	377
Alboran	48,047	1	1.00	0.00	874	0.114	0.0008	38	0.0000	20	173
SWMed	341,085	3	1.33	0.25	7,791	0.039	0.0012	403	0.3402	390	1071
NWMed	135,613	23	1.57	0.09	5,079	0.453	0.0054	732	0.2917	797	1691
Pelagos	87,620	15	1.73	0.15	3,834	0.391	0.0031	269	0.3131	285	663
Tyrrhenian	231,122	3	1.67	0.40	7,008	0.043	0.0002	49	0.4474	37	153
SCMed	152,422	1	1.00	0.00	4,949	0.020	0.0000	1	0.0000	0	5
Adriatic	135,785	0			4,033	0.000	0.0005	66	0.0000	44	262
Ionian	358,703	0			10,728	0.000	0.0000	8	0.0000	2	64
Aegean	191,148	0			5,826	0.000	0.0000	0	0.0000	0	2
NEMed	161,732	0			5,016	0.000	0.0000	0	0.0000	0	0
SEMed EMed	149,321	0			3,111	0.000	0.0000	0		0	0
Total	**2,012,329**	**44**	**1.55**	**0.07**	**56,718**	**0.078**	**0.0008**	**1,570**	**0.2853**	**1855**	**3613**
Atlantic	33,779	2	1.50	0.33	907	0.221	0.0022	75	0.6670	34	377
MedW	582,591	38	1.55	0.08	15,405	0.247	0.0023	1,326	0.2851	1524	3015
MedC	606,729	4	1.50	0.33	18,443	0.022	0.0001	84	0.4436	73	271
Adriatic	135,785	0			4,033	0.000	0.0005	66	0.0000	44	262
MedE	657,452	0			18,895	0.000	0.0000	1	0.0000	0	9
Total	**2,012,329**	**44**	**1.55**	**0.07**	**56,718**	**0.078**	**0.0008**	**1,570**	**0.2853**	**1855**	**3613**

Table 13. Results of the model-based analysis for fin whales (including all balaenopterids, except the minke whale).

Stratum	Area	n groups	mean group size	CV mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33,779	2	1.50	0.33	907	0.221	0.0023	78	0.6702	40	420
Alboran	48,047	1	1.00	0.00	874	0.114	0.0008	36	0.0000	21	184
SWMed	341,085	4	1.25	0.20	7,791	0.051	0.0013	453	0.3359	474	1250
NWMed	135,613	26	1.73	0.10	5,079	0.512	0.0058	786	0.3057	913	2000
Pelagos	87,620	15	1.73	0.15	3,834	0.391	0.0031	272	0.3156	300	709
Tyrrhenian	231,122	3	1.67	0.40	7,008	0.043	0.0002	51	0.4393	44	175
SCMed	152,422	1	1.00	0.00	4,949	0.020	0.0000	1	0.0000	0	5
Adriatic	135,785	0	0.00	0.00	4,033	0.000	0.0004	61	0.0000	45	248
Ionian	358,703	0	0.00	0.00	10,728	0.000	0.0000	10	0.0000	3	72
Aegean	191,148	0	0.00	0.00	5,826	0.000	0.0000	0	0.0000	0	2
NEMed	161,732	0	0.00	0.00	5,016	0.000	0.0000	0	0.0000	0	0
SEMed EMed	149,321	0	0.00	0.00	3,111	0.000	0.0000	0	0.0000	0	0
Total	**2,012,329**	**48**	**1.63**	**0.08**	**56,718**	**0.085**	**0.0008**	**1,653**	**0.2901**	**2073**	**4188**
Atlantic	33,779	2	1.50	0.33	907	0.221	0.0023	78	0.6702	40	420
MedW	582,591	42	1.64	0.09	15,405	0.273	0.0025	1,431	0.2925	1743	3606
MedC	606,729	4	1.50	0.33	18,443	0.022	0.0001	87	0.4487	80	316
Adriatic	135,785	0	0.00	0.00	4,033	0.000	0.0004	61	0.0000	45	248
MedE	657,452	0	0.00	0.00	18,895	0.000	0.0000	1	0.0000	0	10
Total	**2,012,329**	**48**	**1.63**	**0.08**	**56,718**	**0.085**	**0.0008**	**1,653**	**0.2901**	**2073**	**4188**

Table 14. Results of the model-based analysis for Risso's dolphins.

Stratum	**Area**	**n groups**	**mean group size**	**CV mean group size**	**Effort (km)**	**Enc. Rate groups (x100km)**	**Density (Anim./ km^2)**	**Abundance**	**CV**	**95% Confidence Interval**	
Atlantic	33,779	1	15.00	0.00	907	0.110	0.0402	1,358	0.5423	584	3629
Alboran	48,047	8	1.13	0.11	874	0.916	0.0222	1,066	0.3619	605	2099
SWMed	341,085	27	6.48	0.26	7,791	0.347	0.0348	11,878	0.2626	8085	19097
NWMed	135,613	8	5.50	0.36	5,079	0.157	0.0214	2,900	0.2477	2024	4637
Pelagos	87,620	2	2.00	0.50	3,834	0.052	0.0202	1,772	0.3035	1134	3180
Tyrrhenian	231,122	0	0.00	0.00	7,008	0.000	0.0183	4,230	0.3018	2663	7131
SCMed	152,422	0	0.00	0.00	4,949	0.000	0.0041	620	0.3698	342	1253
Adriatic	135,785	3	7.00	0.46	4,033	0.074	0.0033	448	0.7260	211	1611
Ionian	358,703	7	9.43	0.55	10,728	0.065	0.0083	2,963	0.4362	1481	6576
Aegean	191,148	3	6.00	0.25	5,826	0.051	0.0025	485	0.4713	218	1219
NEMed	161,732	0	0.00	0.00	5,016	0.000	0.0029	472	0.6984	154	1550
SEMed EMed	149,321	0	0.00	0.00	3,111	0.000	0.0010	147	0.7765	38	598
Total	**2,012,329**	**58**	**6.03**	**0.18**	**56,718**	**0.102**	**0.0136**	**27,436**	**0.2459**	**19791**	**44094**
Atlantic	33,779	1	15.00	0.00	907	0.110	0.0402	1,358	0.5423	584	3629
MedW	582,591	44	5.23	0.22	15,405	0.286	0.0285	16,605	0.2364	12049	25569
MedC	606,729	5	4.80	0.33	18,443	0.027	0.0120	7,270	0.2942	4666	12640
Adriatic	135,785	3	7.00	0.46	4,033	0.074	0.0033	448	0.7260	211	1611
MedE	657,452	5	12.00	0.59	18,895	0.026	0.0031	2,064	0.5310	933	5571
Total	**2,012,329**	**58**	**6.03**	**0.18**	**56,718**	**0.102**	**0.0136**	**27,436**	**0.2459**	**19791**	**44094**

Table 15. Results of the model-based analysis for bottlenose dolphins.

Stratum	Area	n groups	mean group size	CV mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33,779	7	6.57	0.38	907	0.772	0.1438	4,857	0.4180	2320	10189
Alboran	48,047	12	11.75	0.25	874	1.374	0.1564	7,514	0.3568	3911	14462
SWMed	341,085	8	5.50	0.30	7,791	0.103	0.0112	3,828	0.2690	2583	6877
NWMed	135,613	26	7.46	0.17	5,079	0.512	0.0481	6,526	0.2582	4258	11025
Pelagos	87,620	10	4.80	0.26	3,834	0.261	0.0276	2,414	0.2918	1471	4273
Tyrrhenian	231,122	13	5.46	0.20	7,008	0.186	0.0251	5,807	0.2275	4036	9082
SCMed	152,422	21	6.52	0.38	4,949	0.424	0.0337	5,132	0.2893	3152	8929
Adriatic	135,785	31	4.74	0.19	4,033	0.769	0.0599	8,134	0.2616	5356	13824
Ionian	358,703	10	4.80	0.13	10,728	0.093	0.0065	2,324	0.3547	1379	5101
Aegean	191,148	20	7.05	0.19	5,826	0.343	0.0370	7,072	0.2678	4708	12252
NEMed	161,732	5	38.00	0.94	5,016	0.100	0.0092	1,481	0.4975	735	4155
SEMed											
EMed	149,321	1	1.00	NA	3,111	0.032	0.0033	498	0.9239	129	3003
Total	**2,012,329**	**155**	**7.36**	**0.17**	**56,718**	**0.273**	**0.0284**	**57,120**	**0.1525**	**48626**	**80041**
Atlantic	33,779	7	6.57	0.38	907	0.772	0.1438	4,857	0.4180	2320	10189
MedW	582,591	45	7.87	0.14	15,405	0.292	0.0314	18,307	0.2106	13606	28950
MedC	606,729	45	5.56	0.22	18,443	0.244	0.0216	13,121	0.1888	9735	19308
Adriatic	135,785	31	4.74	0.19	4,033	0.769	0.0599	8,134	0.2616	5356	13824
MedE	657,452	30	11.77	0.50	18,895	0.159	0.0150	9,889	0.2464	7207	17411
Total	**2,012,329**	**155**	**7.36**	**0.17**	**56,718**	**0.273**	**0.0284**	**57,120**	**0.1525**	**48626**	**80041**

Table 16. Results of the model-based analysis for small dolphins (striped, common and unidentified dolphins).

Stratum	Area	n groups	mean group size	CV mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33,779	31	19.58	0.27	907	3.419	2.3844	80,543	0.2031	52883	117983
Alboran	48,047	48	35.44	0.19	874	5.494	2.5890	124,394	0.1852	86809	175840
SWMed	341,085	123	22.26	0.15	7,791	1.579	0.8574	292,455	0.1225	229916	369823
NWMed	135,613	114	19.62	0.14	5,079	2.244	1.0407	141,135	0.1156	115473	176408
Pelagos	87,620	54	16.96	0.26	3,834	1.409	0.5459	47,833	0.1540	35747	64194
Tyrrhenian	231,122	53	16.94	0.15	7,008	0.756	0.2096	48,446	0.1366	37693	63067
SCMed	152,422	5	5.60	0.65	4,949	0.101	0.0467	7,113	0.2419	4427	11276
Adriatic	135,785	9	16.78	0.44	4,033	0.223	0.0521	7,078	0.2641	4518	11698
Ionian	358,703	56	13.18	0.18	10,728	0.522	0.1400	50,225	0.1819	36132	70738
Aegean	191,148	23	17.09	0.17	5,826	0.395	0.0948	18,118	0.2511	11291	29677
NEMed	161,732	7	9.14	0.38	5,016	0.140	0.0387	6,257	0.3392	3567	12361
SEMed											
EMed	149,321	2	5.50	0.45	3,111	0.064	0.0065	976	0.7296	291	3570
Total	**2,012,329**	**507**	**19.59**	**0.07**	**56,718**	**0.894**	**0.3902**	**785,153**	**0.0905**	**673130**	**932689**
Atlantic	33,779	31	19.58	0.27	907	3.419	2.3844	80,543	0.2031	52883	117983
MedW	582,591	327	21.72	0.09	15,405	2.123	0.9729	566,786	0.1105	459250	699854
MedC	606,729	97	14.62	0.11	18,443	0.526	0.1466	88,953	0.1262	71157	113419
Adriatic	135,785	9	16.78	0.44	4,033	0.223	0.0521	7,078	0.2641	4518	11698
MedE	657,452	56	13.88	0.16	18,895	0.296	0.0714	46,964	0.2144	31869	72469
Total	**2,012,329**	**507**	**19.59**	**0.07**	**56,718**	**0.894**	**0.3902**	**785,153**	**0.0905**	**673130**	**932689**

Table 17. Results of the model-based analysis for common or striped dolphins (unidentified to species).

Stratum	Area	n groups	mean group size	CV mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33,779	8	10.25	0.56	907	0.882	0.3737	12,622	0.7170	3597	49046
Alboran	48,047	21	42.86	0.29	874	2.404	1.1957	57,452	0.3405	30471	106595
SWMed	341,085	45	15.69	0.26	7,791	0.578	0.2603	88,779	0.2108	62900	141065
NWMed	135,613	39	12.26	0.15	5,079	0.768	0.1916	25,980	0.2484	16926	42617
Pelagos	87,620	14	9.50	0.30	3,834	0.365	0.0785	6,876	0.3354	3877	13442
Tyrrhenian	231,122	6	17.00	0.44	7,008	0.086	0.0376	8,689	0.4514	3930	20602
SCMed	152,422	0	0.00	0.00	4,949	0.000	0.0265	4,036	0.7387	1246	15309
Adriatic	135,785	0	0.00	0.00	4,033	0.000	0.0058	781	0.6342	243	2463
Ionian	358,703	10	7.50	0.44	10,728	0.093	0.0098	3,520	0.4794	1627	9241
Aegean	191,148	7	17.43	0.30	5,826	0.120	0.0309	5,914	0.5525	2372	17150
NEMed	161,732	0	0.00	0.00	5,016	0.000	0.0035	565	1.0310	100	3486
SEMed											
EMed	149,321	0	0.00	0.00	3,111	0.000	0.0006	94	1.3901	1	736
Total	**2,012,329**	**146**	**17.41**	**0.14**	**56,718**	**0.257**	**0.1117**	**224,694**	**0.1871**	**174707**	**349391**
Atlantic	33,779	8	10.25	0.56	907	0.882	0.3737	12,622	0.7170	3597	49046
MedW	582,591	116	18.68	0.16	15,405	0.753	0.3256	189,693	0.1891	141505	290698
MedC	606,729	16	11.06	0.32	18,443	0.087	0.0242	14,680	0.4749	7144	37234
Adriatic	135,785	0	0.00	0.00	4,033	0.000	0.0058	781	0.6342	243	2463
MedE	657,452	11	12.18	0.32	18,895	0.058	0.0131	8,617	0.6342	4145	27029
Total	**2,012,329**	**146**	**17.41**	**0.14**	**56,718**	**0.257**	**0.1117**	**224,694**	**0.1871**	**174707**	**349391**

Table 18. Results of the model-based analysis for striped dolphins.

Stratum	Area	n groups	mean group size	CV mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33,779	6	10.00	0.35	907	0.662	0.6063	20,480	0.5102	9154	50798
Alboran	48,047	15	29.20	0.43	874	1.717	1.1309	54,336	0.3413	28761	103491
SWMed	341,085	63	28.25	0.19	7,791	0.809	0.4930	168,160	0.1953	123028	245870
NWMed	135,613	56	27.32	0.18	5,079	1.102	0.6564	89,019	0.1816	68255	125262
Pelagos	87,620	36	19.19	0.32	3,834	0.939	0.4499	39,420	0.2123	27326	57841
Tyrrhenian	231,122	36	19.89	0.16	7,008	0.514	0.1961	45,329	0.2318	30836	70621
SCMed	152,422	1	3.00	0.00	4,949	0.020	0.0222	3,388	0.4613	1588	8458
Adriatic	135,785	9	16.78	0.44	4,033	0.223	0.0968	13,138	0.3075	8093	24026
Ionian	358,703	36	14.64	0.23	10,728	0.336	0.1206	43,275	0.2418	29611	69423
Aegean	191,148	6	18.00	0.37	5,826	0.103	0.0328	6,278	0.4348	3010	14768
NEMed	161,732	1	25.00	0.00	5,016	0.020	0.0096	1,552	0.7671	443	6654
SEMed EMed	149,321	0	0.00	0.00	3,111	0.000	0.0012	181	1.1417	15	1412
Total	**2,012,329**	**258**	**21.79**	**0.09**	**56,718**	**0.455**	**0.2347**	**472,343**	**0.1454**	**399904**	**631760**
Atlantic	33,779	6	10.00	0.35	907	0.662	0.6063	20,480	0.5102	9154	50798
MedW	582,591	165	24.48	0.12	15,405	1.071	0.5810	338,479	0.1664	269333	466174
MedC	606,729	63	17.30	0.13	18,443	0.342	0.1315	79,777	0.2003	59421	118654
Adriatic	135,785	9	16.78	0.44	4,033	0.223	0.0968	13,138	0.3075	8093	24026
MedE	657,452	21	16.38	0.30	18,895	0.111	0.0380	24,972	0.3055	16230	48086
Total	**2,012,329**	**258**	**21.79**	**0.09**	**56,718**	**0.455**	**0.2347**	**472,343**	**0.1454**	**399904**	**631760**

Table 19. Comparison of results between design and model based analysis.

Species	n groups	mean group size	CV exp. Group size	Design-based					Model-based				
				Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval		Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Sperm whales	10	3.00	0.26	0.0008	1,443	0.5088	562	3,709					
Fin whales	48	1.65	0.08	0.0009	1,770	0.2835	1,022	3,065	0.0008	1,653	0.2901	2,073	4,188
Risso's dolphins	58	6.03	0.18	0.0137	26,154	0.2898	14,951	45,751	0.0136	27,436	0.2459	19,791	44,094
Bottlenose dolphins	157	6.16	0.10	0.0333	63,398	0.1699	45,514	88,310	0.0284	57,120	0.1525	48,626	80,041
Long-finned pilot whales	14	6.86	0.25	0.0029	5,459	0.4005	2,550	11,684					
Large dolphins	241	6.09	0.08	0.0510	97,822	0.1468	73,444	130,290					
Small dolphins	501	19.41	0.09	0.3866	735,638	0.1269	573,546	943,540	0.3902	785,153	0.0905	673,130	932,689
Striped dolphins	257	21.40	0.10	0.2302	438,037	0.1315	338,680	566,543	0.2347	472,343	0.1454	399,904	631,760
Common dolphins	32	26.31	0.18	0.0343	65,282	0.4013	30,260	140,837					
Striped or common dolphins	148	17.65	0.23	0.1105	210,191	0.2663	125,274	352,671	0.1117	224,694	0.1871	174,707	349,391
Cuvier´s beaked whales	15	3.13	0.20	0.0017	3,157	0.3976	1,476	6,756					
Beaked whales	19	2.84	0.18	0.0019	3,627	0.3605	1,813	7,257					

Table 20. Blocks and sub-blocks with relevant geographic details. All designs were Equal Spaced Zigzag.

Ref	Block	Area (km^2)	Mean % coverage	Mean Total on effort track length
1b	Gulf of Cadiz S-half	49,404	3.2	1572
1c	Gulf of Cadiz N-half-offshore	29,285	3.0	626
1d	Gulf of Cadiz N-half-shelf-East	8,500	3.1	265
1e	Gulf of Cadiz N-half-shelf-West	4,326	3.1	134
2	Alboran	28,123	3.1	877
3	AlgeriaWest complete	109,795	3.0	3345
4	Baleares	93,066	3.0	2758
5	NE_Spain	53,202	3	1592
6	AlgeriaEast complete	66,982	3	2019
7	WestSardinia	73,430	3	2205
8a	GulfLion Shelf	34,718	3.1	1069
8b	GulfLion Deep	46,952	3.1	1470
9	PelagosSW	22,642	2.9	670
10	PelagosNW	34,093	2.9	988
11	PelagosE	31,064	3.1	970
12	TyrrhenianCWest	27,262	2.9	796
13	TyrrhenianCEast	66,588	3	2046
14	TyrrhenianSWest	77,001	3.1	2436
14b	Tunisia 12nm North	10,552	3.2	341
15	TyrrhenianSEast	49,832	3	1524
16	AdriaticNC	78,504	3.1	2456
17	AdriaticS	57,127	2.9	1656
18	IonianN	75,938	2.9	2239
19	IonianS	109,913	3	3288
20	SicilySouth	75,043	3.1	2303
21	Tunisia offshore	47,062	3.1	1460
21b	Tunisia 12nm East	24,568	3.1	778
22a	HellenicTrench North	42,613	3	1299
22b	HellenicTrench West	95,136	3.1	2970
22c	Aegean_TurkeyN	10,019	3	307
22d	Aegean_TurkeyS	11,599	3.1	369
23a	AegeanN_Greece	69,384	2.9	2018
23b	AegeanS_Greece	63,858	3	1898
24	IonianSE	63,515	3	1927
25	LybiaWest	90,100	3	2742
26	LybiaEast	153,863	3	4578
26b	LybiaSirte	73,723	3	2194

27	EgyptWest	108,623	2.9	3145
28	EgyptEast	60,536	3	1825
29a	Cyprus-West	33,608	3.1	1043
29b	Cyprus-NEast	31,598	2.9	961
29b	Cyprus-SEast	43,364	3	1348
29d	Cyprus-SWest	40,838	3	1227
30	Israel	27,324	2.9	821
31	Lebanon offshore	14,555	3.1	471
31b	Lebanon 12nm	4,051	3.3	160
32	Siria	10,133	3.3	362

Seabirds

Strip transect results

Tables 21 to 29 show the results of the strip transect analysis for marine birds. The extrapolation areas have been included to be more comparable to the spatial models results.

Tables 30 to 37 show the results of abundance estimates for the model-based analysis for each species or group. Table 38 show a comparison of results between the strip and model-based analysis.

Table 21. Results of the strip transect analysis for Cory's shearwaters.

Stratum	Area	n groups	n animals	mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33720	8	47	5.88	873	0.009	0.08063	2,724	1.1072	858	8,648
Alboran	28071	2	2	1.00	765	0.003	0.00924	444	5.6241	40	4,952
SWMed	279415	50	87	1.74	6,895	0.007	0.03032	10,342	0.7234	4,474	23,907
NWMed	134760	14	21	1.50	4,471	0.003	0.01363	1,848	2.1238	342	9,992
PelagosW	56756	22	25	1.14	1,036	0.021	0.05069	2,876	0.6239	1,371	6,031
PelagosE	31076	4	54	13.50	2,261	0.002	0.04495	1,396	1.9521	277	7,048
Tyrrhenian	231298	72	111	1.54	7,081	0.010	0.03566	8,241	0.6089	3,990	17,021
SCMed	152961	322	802	2.49	4,592	0.070	0.40664	61,980	0.1727	49,671	77,339
Adriatic	135783	38	275	7.24	3,816	0.010	0.17207	23,365	0.8227	9,231	59,136
Ionian	185926	30	45	1.50	10,488	0.003	0.01439	5,162	2.0833	970	27,470
Aegean	191150	68	100	1.47	5,490	0.012	0.05014	9,585	0.6031	4,668	19,679
NEMed	161669	30	326	10.87	4,811	0.006	0.15927	25,759	0.9263	9,320	71,197
EMed	107687	0	0		2,833	0.000	0.00000	0			
Total	**1902749**	**660**	**1895**	**2.87**	**55,412**	**0.012**	**0.08216**	**165,669**	**0.3278**	**109,650**	**250,307**
Atlantic	33720	8	47	5.88	873	0.009	0.08063	2,724	1.1072	858	8,648
MedW	499002	70	164	2.34	14,393	0.005	0.02603	15,166	0.9105	5,559	41,378
MedC	601262	439	973	2.22	18,011	0.024	0.12764	77,444	0.2594	55,695	107,687
Adriatic	135783	38	275	7.24	3,816	0.010	0.17207	23,365	0.8227	9,231	59,136
MedE	632983	105	436	4.15	18,319	0.006	0.05456	35,868	1.1379	11,052	116,406
Total	**1902749**	**660**	**1895**	**2.87**	**55,412**	**0.012**	**0.08216**	**165,669**	**0.3278**	**109,650**	**250,307**

Table 22. Results of the strip transect analysis for large shearwaters. (including Cory's shearwater)

Stratum	Area	n groups	n animals	mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33720	22	106	4.82	873	0.025	0.16530	5,584	0.6573	2,575	12,108
Alboran	28071	5	6	1.20	765	0.007	0.03408	1,638	2.5221	264	10,157
SWMed	279415	73	112	1.53	6,895	0.011	0.04558	15,548	0.5384	8,103	29,832
NWMed	134760	16	32	2.00	4,471	0.004	0.01918	2,601	1.5888	610	11,085
PelagosW	56756	22	25	1.14	1,036	0.021	0.05069	2,876	0.6239	1,371	6,031
PelagosE	31076	4	54	13.50	2,261	0.002	0.04495	1,396	1.9521	277	7,048
Tyrrhenian	231298	89	189	2.12	7,081	0.013	0.05412	12,509	0.4594	7,108	22,014
SCMed	152961	322	802	2.49	4,592	0.070	0.40664	61,980	0.1727	49,671	77,339
Adriatic	135783	42	283	6.74	3,816	0.011	0.17620	23,925	0.7923	9,712	58,938
Ionian	185926	31	46	1.48	10,488	0.003	0.01458	5,230	2.0346	1,002	27,302
Aegean	191150	194	513	2.64	5,490	0.035	0.28153	53,814	0.5014	29,190	99,208
NEMed	161669	41	343	8.37	4,811	0.009	0.17409	28,156	0.8275	11,077	71,567
EMed	107687	9	11	1.22	2,833	0.003	0.01217	1,817	2.9046	262	12,585
Total	**1902749**	**870**	**2522**	**2.90**	**55,412**	**0.016**	**0.11436**	**230,580**	**0.2712**	**163,440**	**325,301**
Atlantic	33720	22	106	4.82	873	0.025	0.16530	5,584	0.6573	2,575	12,108
MedW	499002	98	204	2.08	14,393	0.007	0.03654	21,290	0.6366	10,022	45,224
MedC	601262	457	1052	2.30	18,011	0.025	0.13592	82,468	0.2373	60,954	111,576
Adriatic	135783	42	283	6.74	3,816	0.011	0.17620	23,925	0.7923	9,712	58,938
MedE	632983	251	877	3.49	18,319	0.014	0.13367	87,883	0.5611	44,711	172,741
Total	**1902749**	**870**	**2522**	**2.90**	**55,412**	**0.016**	**0.11436**	**230,580**	**0.2712**	**163,440**	**325,301**

Table 23. Results of the strip transect analysis for small shearwaters.

Stratum	Area	n groups	n animals	mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33720	0	0		873	0.000	0.00000	0			
Alboran	28071	2	38	19.00	765	0.003	0.07299	3,507	1.2531	1,000	12,302
SWMed	279415	35	43	1.23	6,895	0.005	0.01495	5,098	1.1897	1,516	17,146
NWMed	134760	13	532	40.92	4,471	0.003	0.24292	32,944	0.4396	19,141	56,698
PelagosW	56756	8	46	5.75	1,036	0.008	0.07075	4,014	0.7743	1,656	9,729
PelagosE	31076	8	87	10.88	2,261	0.004	0.07201	2,237	1.5353	540	9,268
Tyrrhenian	231298	13	127	9.77	7,081	0.002	0.01947	4,500	1.9679	886	22,863
SCMed	152961	8	22	2.75	4,592	0.002	0.01106	1,686	3.6599	205	13,895
Adriatic	135783	6	61	10.17	3,816	0.002	0.03279	4,453	1.7565	962	20,611
Ionian	185926	22	70	3.18	10,488	0.002	0.01483	5,319	2.4109	889	31,830
Aegean	191150	132	706	5.35	5,490	0.024	0.23203	44,352	0.2180	33,575	58,588
NEMed	161669	0	0		4,811	0.000	0.00000	0			
EMed	107687	2	4	2.00	2,833	0.001	0.00293	437	6.0329	37	5,103
Total	**1902749**	**249**	**1736**	**6.97**	**55,412**	**0.004**	**0.05856**	**118,067**	**0.3591**	**75,291**	**185,148**
Atlantic	33720	0	0		873	0.000	0.00000	0			
MedW	499002	58	700	12.07	14,393	0.004	0.09835	57,300	0.5528	29,410	111,640
MedC	601262	37	209	5.65	18,011	0.002	0.01666	10,110	1.3152	2,771	36,890
Adriatic	135783	6	61	10.17	3,816	0.002	0.03279	4,453	1.7565	962	20,611
MedE	632983	148	766	5.18	18,319	0.008	0.08195	53,876	0.3523	34,634	83,808
Total	**1902749**	**249**	**1736**	**6.97**	**55,412**	**0.004**	**0.05856**	**118,067**	**0.3591**	**75,291**	**185,148**

Table 24. Results of the strip transect analysis for all shearwaters.

Stratum	Area	n groups	n animals	mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33720	22	106	4.82	873	0.025	0.16530	5,584	0.6573	2,575	12,108
Alboran	28071	7	44	6.29	765	0.009	0.10708	5,145	0.8601	1,968	13,452
SWMed	279415	108	155	1.44	6,895	0.016	0.06053	20,646	0.3909	12,685	33,603
NWMed	134760	29	564	19.45	4,471	0.006	0.26210	35,545	0.3969	21,688	58,255
PelagosW	56756	30	71	2.37	1,036	0.029	0.12144	6,890	0.3980	4,199	11,306
PelagosE	31076	12	141	11.75	2,261	0.005	0.11696	3,633	1.2062	1,068	12,357
Tyrrhenian	231298	102	316	3.10	7,081	0.014	0.07359	17,009	0.4205	10,100	28,644
SCMed	152961	330	824	2.50	4,592	0.072	0.41769	63,666	0.1681	51,317	78,986
Adriatic	135783	48	344	7.17	3,816	0.013	0.20899	28,378	0.6193	13,595	59,235
Ionian	185926	53	116	2.19	10,488	0.005	0.02941	10,548	1.1549	3,212	34,640
Aegean	191150	326	1219	3.74	5,490	0.059	0.51356	98,165	0.2069	75,356	127,879
NEMed	161669	41	343	8.37	4,811	0.009	0.17409	28,156	0.8275	11,077	71,567
EMed	107687	11	15	1.36	2,833	0.004	0.01510	2,254	2.0893	423	12,023
Total	**1902749**	**1119**	**4258**	**3.81**	**55,412**	**0.020**	**0.17291**	**348,648**	**0.1643**	**282,383**	**430,461**
Atlantic	33720	22	106	4.82	873	0.025	0.16530	5,584	0.6573	2,575	12,108
MedW	499002	156	904	5.79	14,393	0.011	0.13490	78,590	0.3817	48,808	126,545
MedC	601262	494	1261	2.55	18,011	0.027	0.15259	92,579	0.2032	71,398	120,044
Adriatic	135783	48	344	7.17	3,816	0.013	0.20899	28,378	0.6193	13,595	59,235
MedE	632983	399	1643	4.12	18,319	0.022	0.21562	141,758	0.2837	98,963	203,060
Total	**1902749**	**1119**	**4258**	**3.81**	**55,412**	**0.020**	**0.17291**	**348,648**	**0.1643**	**282,383**	**430,461**

Table 25. Results of the strip transect analysis for gannets.

Stratum	Area	n groups	n animals	mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33720	28	126	4.50	873	0.032	0.22374	7,558	0.4267	4,456	12,818
Alboran	28071	4	4	1.00	765	0.005	0.01808	868	3.9025	101	7,503
SWMed	279415	0	0		6,895	0.000	0.00000	0			
NWMed	134760	0	0		4,471	0.000	0.00000	0			
PelagosW	56756	0	0		1,036	0.000	0.00000	0			
PelagosE	31076	0	0		2,261	0.000	0.00000	0			
Tyrrhenian	231298	2	3	1.50	7,081	0.000	0.00128	295	12.5590	16	5,404
SCMed	152961	3	3	1.00	4,592	0.001	0.00146	223	8.4233	15	3,224
Adriatic	135783	0	0		3,816	0.000	0.00000	0			
Ionian	185926	0	0		10,488	0.000	0.00000	0			
Aegean	191150	2	3	1.50	5,490	0.000	0.00125	238	10.5673	14	3,950
NEMed	161669	0	0		4,811	0.000	0.00000	0			
EMed	107687	0	0		2,833	0.000	0.00000	0			
Total	**1902749**	**39**	**139**	**3.56**	**55,412**	**0.001**	**0.00505**	**10,192**	**2.5630**	**1,623**	**64,022**
Atlantic	33720	28	126	4.50	873	0.032	0.22374	7,558	0.4267	4,456	12,818
MedW	499002	4	4	1.00	14,393	0.000	0.00132	767	14.5091	39	15,232
MedC	601262	5	6	1.20	18,011	0.000	0.00093	567	9.3353	37	8,725
Adriatic	135783	0	0		3,816	0.000	0.00000	0			
MedE	632983	2	3	1.50	18,319	0.000	0.00040	262	18.6958	12	5,978
Total	**1902749**	**39**	**139**	**3.56**	**55,412**	**0.001**	**0.00505**	**10,192**	**2.5630**	**1,623**	**64,022**

Table 26. Results of the strip transect analysis for terns.

Stratum	Area	n groups	n animals	mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33720	0	0		873	0.000	0.00000	0			
Alboran	28071	0	0		765	0.000	0.00000	0			
SWMed	279415	20	27	1.35	6,895	0.003	0.00995	3,392	1.5143	828	13,897
NWMed	134760	7	9	1.29	4,471	0.002	0.00291	394	3.2804	52	2,997
PelagosW	56756	2	2	1.00	1,036	0.002	0.01033	586	5.4114	54	6,364
PelagosE	31076	0	0		2,261	0.000	0.00000	0			
Tyrrhenian	231298	10	21	2.10	7,081	0.001	0.00991	2,290	3.7595	272	19,251
SCMed	152961	0	0		4,592	0.000	0.00000	0			
Adriatic	135783	46	63	1.37	3,816	0.012	0.04276	5,806	0.8957	2,155	15,648
Ionian	185926	8	12	1.50	10,488	0.001	0.00431	1,545	5.9071	134	17,803
Aegean	191150	6	8	1.33	5,490	0.001	0.00324	619	3.7594	74	5,204
NEMed	161669	0	0		4,811	0.000	0.00000	0			
EMed	107687	0	0		2,833	0.000	0.00000	0			
Total	**1902749**	**99**	**142**	**1.43**	**55,412**	**0.002**	**0.00769**	**15,515**	**1.3144**	**4,254**	**56,580**
Atlantic	33720	0	0		873	0.000	0.00000	0			
MedW	499002	27	36	1.33	14,393	0.002	0.00545	3,177	1.6950	707	14,281
MedC	601262	13	24	1.85	18,011	0.001	0.00506	3,069	4.6535	313	30,051
Adriatic	135783	46	63	1.37	3,816	0.012	0.04276	5,806	0.8957	2,155	15,648
MedE	632983	13	19	1.46	18,319	0.001	0.00344	2,259	4.6314	231	22,045
Total	**1902749**	**99**	**142**	**1.43**	**55,412**	**0.002**	**0.00769**	**15,515**	**1.3144**	**4,254**	**56,580**

Table 27. Results of the strip transect analysis for storm petrels.

Stratum	Area	n groups	n animals	mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33720	0	0		873	0.000	0.00000	0			
Alboran	28071	0	0		765	0.000	0.00000	0			
SWMed	279415	1	1	1.00	6,895	0.000	0.00021	72	26.0768	3	1,943
NWMed	134760	6	6	1.00	4,471	0.001	0.00327	443	4.5722	46	4,286
PelagosW	56756	0	0		1,036	0.000	0.00000	0			
PelagosE	31076	0	0		2,261	0.000	0.00000	0			
Tyrrhenian	231298	6	10	1.67	7,081	0.001	0.00193	446	4.8255	44	4,483
SCMed	152961	4	4	1.00	4,592	0.001	0.00165	252	5.8553	22	2,886
Adriatic	135783	2	2	1.00	3,816	0.001	0.00148	201	12.6389	11	3,700
Ionian	185926	8	15	1.88	10,488	0.001	0.00385	1,382	4.9957	134	14,217
Aegean	191150	2	2	1.00	5,490	0.000	0.00071	135	12.2184	8	2,439
NEMed	161669	0	0		4,811	0.000	0.00000	0			
EMed	107687	1	1	1.00	2,833	0.000	0.00319	477	16.0624	23	10,017
Total	**1902749**	**30**	**41**	**1.37**	**55,412**	**0.001**	**0.00172**	**3,474**	**3.4517**	**440**	**27,421**
Atlantic	33720	0	0		873	0.000	0.00000	0			
MedW	499002	7	7	1.00	14,393	0.000	0.00110	640	7.0997	49	8,313
MedC	601262	18	29	1.61	18,011	0.001	0.00334	2,026	3.2702	267	15,357
Adriatic	135783	2	2	1.00	3,816	0.001	0.00148	201	12.6389	11	3,700
MedE	632983	3	3	1.00	18,319	0.000	0.00067	439	17.5378	20	9,670
Total	**1902749**	**30**	**41**	**1.37**	**55,412**	**0.001**	**0.00172**	**3,474**	**3.4517**	**440**	**27,421**

Table 28. Results of the strip transect analysis for small gulls.

Stratum	Area	n groups	n animals	mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33720	6	9	1.50	873	0.007	0.04286	1,448	2.1285	267	7,841
Alboran	28071	9	35	3.89	765	0.012	0.09663	4,643	1.0998	1,470	14,664
SWMed	279415	34	133	3.91	6,895	0.005	0.04569	15,585	1.4422	3,960	61,332
NWMed	134760	47	211	4.49	4,471	0.011	0.15660	21,236	0.6386	9,977	45,202
PelagosW	56756	2	4	2.00	1,036	0.002	0.00667	378	3.8634	44	3,244
PelagosE	31076	2	8	4.00	2,261	0.001	0.02527	785	5.2727	74	8,380
Tyrrhenian	231298	19	37	1.95	7,081	0.003	0.01869	4,320	1.6699	973	19,181
SCMed	152961	11	13	1.18	4,592	0.002	0.00542	825	2.3067	143	4,769
Adriatic	135783	81	207	2.56	3,816	0.021	0.11486	15,596	0.5450	8,071	30,138
Ionian	185926	6	6	1.00	10,488	0.001	0.00380	1,363	8.7920	92	20,229
Aegean	191150	58	532	9.17	5,490	0.011	1.06303	203,197	0.9313	73,215	563,941
NEMed	161669	25	37	1.48	4,811	0.005	0.03128	5,058	1.2963	1,403	18,240
EMed	107687	6	7	1.17	2,833	0.002	0.00572	853	2.9615	121	5,999
Total	**1902749**	**306**	**1239**	**4.05**	**55,412**	**0.006**	**0.14366**	**289,672**	**1.4354**	**73,898**	**1,135,477**
Atlantic	33720	6	9	1.50	873	0.007	0.04286	1,448	2.1285	267	7,841
MedW	499002	92	387	4.21	14,393	0.006	0.08012	46,680	0.6233	22,270	97,842
MedC	601262	35	57	1.63	18,011	0.002	0.01032	6,260	1.6606	1,416	27,669
Adriatic	135783	81	207	2.56	3,816	0.021	0.11486	15,596	0.5450	8,071	30,138
MedE	632983	92	579	6.29	18,319	0.005	0.34985	230,012	1.5342	55,548	952,433
Total	**1902749**	**306**	**1239**	**4.05**	**55,412**	**0.006**	**0.14366**	**289,672**	**1.4354**	**73,898**	**1,135,477**

Table 29. Results of the strip transect analysis for large gulls.

Stratum	Area	n groups	n animals	mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33720	26	133	5.12	873	0.030	0.22666	7,656	0.3972	4,670	12,552
Alboran	28071	8	20	2.50	765	0.010	0.06894	3,312	1.2238	963	11,398
SWMed	279415	68	201	2.96	6,895	0.010	0.08505	29,008	0.5744	14,554	57,817
NWMed	134760	114	748	6.56	4,471	0.025	0.28787	39,038	0.2627	27,962	54,502
PelagosW	56756	79	300	3.80	1,036	0.076	0.72197	40,960	0.2677	29,159	57,538
PelagosE	31076	50	98	1.96	2,261	0.022	0.10197	3,168	0.7544	1,331	7,538
Tyrrhenian	231298	88	459	5.22	7,081	0.012	0.19319	44,650	0.4592	25,376	78,561
SCMed	152961	136	300	2.21	4,592	0.030	0.15504	23,631	0.3060	16,057	34,778
Adriatic	135783	186	1464	7.87	3,816	0.049	1.00095	135,913	0.2200	102,638	179,976
Ionian	185926	46	113	2.46	10,488	0.004	0.03757	13,478	1.0282	4,500	40,370
Aegean	191150	147	1255	8.54	5,490	0.027	0.98022	187,366	0.2388	138,225	253,978
NEMed	161669	7	14	2.00	4,811	0.001	0.00589	952	3.8499	111	8,142
EMed	107687	2	2	1.00	2,833	0.001	0.00242	361	11.3578	21	6,245
Total	**1902749**	**957**	**5107**	**5.34**	**55,412**	**0.017**	**0.28659**	**577,854**	**0.1840**	**456,534**	**731,414**
Atlantic	33720	26	133	5.12	873	0.030	0.22666	7,656	0.3972	4,670	12,552
MedW	499002	240	1067	4.45	14,393	0.017	0.14884	86,713	0.2636	62,041	121,196
MedC	601262	309	1065	3.45	18,011	0.017	0.16814	102,013	0.2855	71,058	146,454
Adriatic	135783	186	1464	7.87	3,816	0.049	1.00095	135,913	0.2200	102,638	179,976
MedE	632983	196	1378	7.03	18,319	0.011	0.33594	220,866	0.3783	137,712	354,231
Total	**1902749**	**957**	**5107**	**5.34**	**55,412**	**0.017**	**0.28659**	**577,854**	**0.1840**	**456,534**	**731,414**

Table 30. Results of the model-based analysis for sunfish.

Stratum	Area	n groups	mean group size	CV mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33,779	13	1.00	0.0000	907	1.434	0.0308	1,346	0.2704	827	2,352
Alboran	48,047	19	1.00	0.0000	874	2.175	0.0486	3,072	0.2086	2,070	4,694
SWMed	341,085	48	1.13	0.1111	7,791	0.616	0.0155	5,930	0.1264	4,866	7,734
NWMed	135,613	166	1.13	0.0256	5,079	3.268	0.0835	13,387	0.0749	11,742	15,560
Pelagos	87,620	63	1.08	0.0381	3,834	1.643	0.0421	4,679	0.1121	3,785	5,836
Tyrrhenian	231,122	7	1.00	0.0000	7,008	0.100	0.0027	706	0.2829	441	1,270
SCMed	152,422	10	1.10	0.0909	4,949	0.202	0.0035	629	0.3505	340	1,294
Adriatic	135,785	11	1.00	0.0000	4,033	0.273	0.0058	996	0.2952	594	1,855
Ionian	358,703	7	1.00	0.0000	10,728	0.065	0.0020	821	0.2935	511	1,604
Aegean	191,148	8	1.00	0.0000	5,826	0.137	0.0024	581	0.3676	304	1,261
NEMed	161,732	3	1.00	0.0000	5,016	0.060	0.0018	324	0.4756	157	883
EMed	149,321	3	1.67	0.4000	3,111	0.096	0.0030	481	0.5213	228	1,473
Total	**2,012,329**	**342**	**1.11**	**0.0222**	**56,718**	**0.603**	**0.0136**	**31,131**	**0.0580**	**29,090**	**35,731**
Atlantic	33,779	13	1.00	0.0000	907	1.434	0.0308	1,346	0.2704	827	2,352
MedW	582,591	268	1.12	0.0268	15,405	1.740	0.0379	24,524	0.0634	22,239	27,864
MedC	606,729	38	1.05	0.0349	18,443	0.206	0.0043	2,921	0.1571	2,306	4,225
Adriatic	135,785	11	1.00	0.0000	4,033	0.273	0.0058	996	0.2952	594	1,855
MedE	657,452	14	1.14	0.1250	18,895	0.074	0.0020	1,575	0.2693	1,130	3,060
Total	**2,012,329**	**342**	**1.11**	**0.0222**	**56,718**	**0.603**	**0.0136**	**31,131**	**0.0580**	**29,090**	**35,731**

Table 31. Results of the model-based analysis for Cory's shearwaters.

Stratum	Area	n groups	mean group size	CV mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33,779	8	5.88	0.8298	907	0.882	0.0365	1,596	0.5105	667	4,305
Alboran	48,047	2	1.00	0.0000	874	0.229	0.0607	3,837	0.3935	1,992	8,731
SWMed	341,085	55	1.80	0.1332	7,791	0.706	0.0286	10,908	0.1990	8,099	17,211
NWMed	135,613	16	1.56	0.1845	5,079	0.315	0.0221	3,551	0.2424	2,411	6,183
Pelagos	87,620	35	2.60	0.5373	3,834	0.913	0.0416	4,619	0.2461	3,239	7,133
Tyrrhenian	231,122	61	1.62	0.1282	7,008	0.870	0.0539	14,048	0.1541	10,873	19,212
SCMed	152,422	340	2.41	0.1150	4,949	6.870	0.3030	54,748	0.2849	45,155	75,261
Adriatic	135,785	39	7.15	0.5556	4,033	0.967	0.0672	11,481	0.3527	8,432	19,046
Ionian	358,703	34	1.44	0.1249	10,728	0.317	0.0203	8,308	0.1595	6,502	11,811
Aegean	191,148	80	4.76	0.5379	5,826	1.373	0.0739	17,959	0.2566	13,190	26,213
NEMed	161,732	31	10.55	0.6201	5,016	0.618	0.0188	3,364	0.2825	2,141	5,720
EMed	149,321	0	0.00	0.0000	3,111	0.000	0.0000	1	0.0000	0	11
Total	**2,012,329**	**666**	**2.85**	**0.1482**	**56,718**	**1.174**	**0.0561**	**128,192**	**0.2832**	**116,476**	**167,641**
Atlantic	33,779	8	5.88	0.8298	907	0.882	0.0365	1,596	0.5105	667	4,305
MedW	582,591	75	2.36	0.2840	15,405	0.487	0.0296	19,162	0.2064	14,927	29,725
MedC	606,729	442	2.21	0.0981	18,443	2.397	0.1090	73,484	0.2249	63,321	97,632
Adriatic	135,785	39	7.15	0.5556	4,033	0.967	0.0672	11,481	0.3527	8,432	19,046
MedE	657,452	111	3.98	0.4647	18,895	0.587	0.0304	23,539	0.2427	18,437	32,996
Total	**2,012,329**	**666**	**2.85**	**0.1482**	**56,718**	**1.174**	**0.0561**	**128,192**	**0.2832**	**116,476**	**167,641**

Table 32. Results of the model-based analysis for large shearwaters.

Stratum	Area	n groups	mean group size	CV mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33,779	25	4.56	0.4148	907	2.757	0.2518	11,015	0.3606	6,310	24,064
Alboran	48,047	6	1.17	0.1429	874	0.687	0.1840	11,636	0.3653	6,562	26,145
SWMed	341,085	78	1.59	0.1092	7,791	1.001	0.0644	24,574	0.2500	17,288	43,831
NWMed	135,613	19	1.95	0.2619	5,079	0.374	0.0416	6,665	0.2236	4,674	11,199
Pelagos	87,620	40	2.40	0.5096	3,834	1.043	0.0547	6,077	0.2142	4,371	8,930
Tyrrhenian	231,122	78	2.27	0.2868	7,008	1.113	0.0756	19,727	0.1550	15,985	26,219
SCMed	152,422	340	2.41	0.1150	4,949	6.870	0.3049	55,085	0.2340	45,917	74,876
Adriatic	135,785	43	6.67	0.5406	4,033	1.066	0.1148	19,619	0.2031	14,991	28,508
Ionian	358,703	35	1.43	0.1227	10,728	0.326	0.0215	8,807	0.1443	6,992	12,308
Aegean	191,148	206	3.85	0.3171	5,826	3.536	0.2346	57,010	0.2147	45,117	81,094
NEMed	161,732	42	8.19	0.5918	5,016	0.837	0.0329	5,894	0.2425	4,180	9,306
EMed	149,321	9	1.22	0.1203	3,111	0.289	0.0083	1,330	0.6027	554	4,192
Total	**2,012,329**	**878**	**2.89**	**0.1274**	**56,718**	**1.548**	**0.0957**	**218,647**	**0.1628**	**200,761**	**280,881**
Atlantic	33,779	25	4.56	0.4148	907	2.757	0.2518	11,015	0.3606	6,310	24,064
MedW	582,591	104	2.10	0.2346	15,405	0.675	0.0665	43,019	0.2362	32,034	73,946
MedC	606,729	460	2.29	0.1018	18,443	2.494	0.1197	80,753	0.1768	70,363	104,495
Adriatic	135,785	43	6.67	0.5406	4,033	1.066	0.1148	19,619	0.2031	14,991	28,508
MedE	657,452	258	3.43	0.2855	18,895	1.365	0.0847	65,543	0.2070	53,628	91,488
Total	**2,012,329**	**878**	**2.89**	**0.1274**	**56,718**	**1.548**	**0.0957**	**218,647**	**0.1628**	**200,761**	**280,881**

Table 33. Results of the model-based analysis for small shearwaters.

Stratum	Area	n groups	mean group size	CV mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33,779	0	0.00	0.0000	907	0.000	0.0746	3,265	0.0000	1,358	13,294
Alboran	48,047	2	19.00	0.5789	874	0.229	0.0451	2,854	0.5462	1,357	8,573
SWMed	341,085	36	1.22	0.1387	7,784	0.463	0.0341	12,871	0.1923	9,531	19,375
NWMed	135,613	16	33.44	0.3586	5,079	0.315	0.1791	28,723	0.3337	17,253	55,621
Pelagos	87,620	17	7.88	0.5919	3,834	0.443	0.0609	6,809	0.2637	4,625	10,914
Tyrrhenian	231,122	14	9.14	0.5952	7,008	0.200	0.0266	6,953	0.2031	5,338	9,522
SCMed	152,422	9	2.89	0.5364	4,949	0.182	0.0298	5,408	0.2773	3,820	10,022
Adriatic	135,785	7	8.86	0.7769	4,033	0.174	0.0913	15,609	0.2818	10,633	27,167
Ionian	358,703	23	3.30	0.5114	10,728	0.214	0.0220	8,999	0.3595	6,541	15,050
Aegean	191,148	135	5.25	0.1725	5,826	2.317	0.1811	44,001	0.2644	30,591	72,175
NEMed	161,732	0	0.00	0.0000	5,016	0.000	0.0029	512	0.0000	324	1,002
EMed	149,321	2	2.00	0.0000	3,111	0.064	0.0022	351	0.6746	173	1,380
Total	**2,012,329**	**253**	**6.88**	**0.1609**	**56,718**	**0.446**	**0.0584**	**133,468**	**0.2393**	**106,607**	**206,853**
Atlantic	33,779	0	0.00	0.0000	907	0.000	0.0746	3,265	0.0000	1,358	13,294
MedW	582,591	59	11.88	0.3266	15,405	0.383	0.0738	47,745	0.2696	35,821	78,266
MedC	606,729	39	5.41	0.3798	18,443	0.211	0.0246	16,623	0.2485	13,461	24,117
Adriatic	135,785	7	8.86	0.7769	4,033	0.174	0.0913	15,609	0.2818	10,633	27,167
MedE	657,452	152	5.07	0.1664	18,895	0.804	0.0662	51,234	0.2470	37,220	83,684
Total	**2,012,329**	**253**	**6.88**	**0.1609**	**56,718**	**0.446**	**0.0584**	**133,468**	**0.2393**	**106,607**	**206,853**

Table 34. Results of the model-based analysis for all shearwaters.

Stratum	**Area**	**n groups**	**mean group size**	**CV mean group size**	**Effort (km)**	**Enc. Rate groups (x100km)**	**Density (Anim./ km²)**	**Abundance**	**CV**	**95% Confidence Interval**	
Atlantic	33,779	25	4.56	0.4148	907	2.757	0.2516	11,006	0.3094	6,891	21,982
Alboran	48,047	8	5.63	0.6374	874	0.916	0.1368	8,650	0.2680	5,648	15,469
SWMed	341,085	114	1.47	0.0888	7,791	1.463	0.0804	30,673	0.1083	25,980	39,473
NWMed	135,613	35	16.34	0.3687	5,079	0.689	0.2574	41,274	0.1894	31,108	61,323
Pelagos	87,620	57	4.04	0.4071	3,834	1.487	0.1087	12,074	0.1659	9,516	16,342
Tyrrhenian	231,122	92	3.32	0.3038	7,008	1.313	0.1044	27,222	0.1305	23,110	33,949
SCMed	152,422	349	2.43	0.1125	4,949	7.052	0.3085	55,727	0.1291	47,017	73,019
Adriatic	135,785	50	6.98	0.4625	4,033	1.240	0.1845	31,526	0.3298	25,476	44,823
Ionian	358,703	58	2.17	0.3132	10,728	0.541	0.0573	23,481	0.1297	19,735	30,188
Aegean	191,148	341	4.41	0.1862	5,826	5.853	0.3952	96,039	0.1491	81,184	123,833
NEMed	161,732	42	8.19	0.5918	5,016	0.837	0.0247	4,429	0.2068	3,308	6,405
EMed	149,321	11	1.36	0.1116	3,111	0.354	0.0179	2,869	0.2993	1,793	5,787
Total	**2,012,329**	**1,131**	**3.78**	**0.1008**	**56,718**	**1.994**	**0.1459**	**333,270**	**0.1257**	**305,384**	**402,446**
Atlantic	33,779	25	4.56	0.4148	907	2.757	0.2516	11,006	0.3094	6,891	21,982
MedW	582,591	163	5.64	0.2623	15,405	1.058	0.1284	83,068	0.1521	70,414	109,485
MedC	606,729	499	2.54	0.1064	18,443	2.706	0.1383	93,288	0.1078	83,853	114,721
Adriatic	135,785	50	6.98	0.4625	4,033	1.240	0.1845	31,526	0.3298	25,476	44,823
MedE	657,452	410	4.03	0.1712	18,895	2.170	0.1509	116,810	0.1422	101,210	147,873
Total	**2,012,329**	**1,131**	**3.78**	**0.1008**	**56,718**	**1.994**	**0.1459**	**333,270**	**0.1257**	**305,384**	**402,446**

Table 35. Results of the model-based analysis for terns.

Stratum	Area	n groups	mean group size	CV mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33,779	0	0.00	0.0000	907	0.000	0.0000	1	0.0000	0	9
Alboran	48,047	0	0.00	0.0000	874	0.000	0.0014	88	0.0000	11	696
SWMed	341,085	20	1.35	0.0973	7,791	0.257	0.0070	2,663	0.3352	1,617	5,559
NWMed	135,613	7	1.29	0.2222	5,079	0.138	0.0036	577	0.5707	280	1,737
Pelagos	87,620	2	1.00	0.0000	3,834	0.052	0.0021	230	0.7230	76	936
Tyrrhenian	231,122	7	2.57	0.2664	7,008	0.100	0.0059	1,546	0.3615	890	3,492
SCMed	152,422	0	0.00	0.0000	4,949	0.000	0.0000	8	0.0000	1	71
Adriatic	135,785	49	1.35	0.0797	4,033	1.215	0.0402	6,866	0.2662	4,630	12,627
Ionian	358,703	8	1.50	0.2520	10,728	0.075	0.0018	743	0.4949	420	2,139
Aegean	191,148	6	1.33	0.1581	5,826	0.103	0.0036	880	0.5754	422	3,153
NEMed	161,732	0	0.00	0.0000	5,016	0.000	0.0002	28	0.0000	4	231
EMed	149,321	0	0.00	0.0000	3,111	0.000	0.0000	1	0.0000	0	7
Total	**2,012,329**	**99**	**1.43**	**0.0618**	**56,718**	**0.175**	**0.0059**	**13,469**	**0.6748**	**11,731**	**61,959**
Atlantic	33,779	0	0.00	0.0000	907	0.000	0.0000	1	0.0000	0	9
MedW	582,591	27	1.33	0.0895	15,405	0.175	0.0053	3,405	0.3408	2,357	7,214
MedC	606,729	10	2.10	0.2505	18,443	0.054	0.0030	2,042	0.4683	1,335	4,817
Adriatic	135,785	49	1.35	0.0797	4,033	1.215	0.0402	6,866	0.2662	4,630	12,627
MedE	657,452	13	1.46	0.1664	18,895	0.069	0.0017	1,286	0.6585	822	6,026
Total	**2,012,329**	**99**	**1.43**	**0.0618**	**56,718**	**0.175**	**0.0059**	**13,469**	**0.6748**	**11,731**	**61,959**

Table 36. Results of the model-based analysis for small gulls.

Stratum	Area	n groups	mean group size	CV mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33,779	6	1.50	0.2277	907	0.662	0.0481	2,105	0.7397	580	7,954
Alboran	48,047	10	3.70	0.5145	874	1.145	0.1476	9,333	0.5499	3,243	25,315
SWMed	341,085	35	3.83	0.5875	7,791	0.449	0.0385	14,690	0.3158	8,970	28,576
NWMed	135,613	49	4.35	0.2664	5,079	0.965	0.1301	20,861	0.2394	13,526	34,039
Pelagos	87,620	4	3.00	0.3600	3,834	0.104	0.0083	919	0.4804	429	2,372
Tyrrhenian	231,122	14	2.21	0.4496	7,008	0.200	0.0105	2,727	0.3644	1,399	5,548
SCMed	152,422	11	1.18	0.1032	4,949	0.222	0.0051	916	0.5773	362	2,699
Adriatic	135,785	86	2.48	0.3738	4,033	2.132	0.0909	15,540	0.1749	11,439	22,433
Ionian	358,703	7	1.00	0.0000	10,728	0.065	0.0062	2,561	0.3149	1,496	5,053
Aegean	191,148	58	9.17	0.4231	5,826	0.996	0.1748	42,480	0.1841	30,748	62,543
NEMed	161,732	27	1.44	0.1860	5,016	0.538	0.0121	2,171	0.3479	1,230	4,443
EMed	149,321	6	1.17	0.1429	3,111	0.193	0.0099	1,587	0.8201	531	7,656
Total	**2,012,329**	**306**	**4.05**	**0.2108**	**56,718**	**0.540**	**0.0497**	**113,532**	**0.1197**	**96,801**	**156,959**
Atlantic	33,779	6	1.50	0.2277	907	0.662	0.0481	2,105	0.7397	580	7,954
MedW	582,591	94	4.17	0.2498	15,405	0.610	0.0671	43,436	0.2452	29,132	76,233
MedC	606,729	30	1.70	0.2766	18,443	0.163	0.0090	6,091	0.2656	4,176	11,213
Adriatic	135,785	86	2.48	0.3738	4,033	2.132	0.0909	15,540	0.1749	11,439	22,433
MedE	657,452	92	6.29	0.3927	18,895	0.487	0.0602	46,636	0.1605	36,273	67,652
Total	**2,012,329**	**306**	**4.05**	**0.2108**	**56,718**	**0.540**	**0.0497**	**113,532**	**0.1197**	**96,801**	**156,959**

Table 37. Results of the model-based analysis for large gulls.

Stratum	Area	n groups	mean group size	CV mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33,779	26	5.12	0.4019	907	2.867	0.3344	14,628	0.3731	7,523	30,764
Alboran	48,047	9	2.33	0.4345	874	1.030	0.1464	9,258	0.3840	4,728	19,736
SWMed	341,085	71	2.89	0.2618	7,791	0.911	0.0572	21,845	0.2226	15,210	34,513
NWMed	135,613	120	6.29	0.4201	5,079	2.362	0.4319	69,259	0.1763	49,258	99,917
Pelagos	87,620	138	2.99	0.2660	3,834	3.600	0.2969	32,977	0.1711	23,677	46,887
Tyrrhenian	231,122	69	3.77	0.2768	7,008	0.985	0.1450	37,823	0.1524	28,452	52,387
SCMed	152,422	139	2.18	0.2024	4,949	2.809	0.1064	19,230	0.1379	15,069	26,006
Adriatic	135,785	207	8.04	0.2793	4,033	5.132	1.0466	178,877	0.1347	141,236	241,525
Ionian	358,703	46	2.46	0.4352	10,728	0.429	0.0196	8,035	0.2551	5,238	13,661
Aegean	191,148	149	8.48	0.2169	5,826	2.557	0.4485	108,991	0.1632	81,862	153,503
NEMed	161,732	7	2.00	0.2887	5,016	0.140	0.0100	1,782	0.4256	829	4,135
EMed	149,321	2	1.00	0.0000	3,111	0.064	0.0021	336	1.1323	31	2,571
Total	**2,012,329**	**958**	**5.33**	**0.1276**	**56,718**	**1.689**	**0.2162**	**493,695**	**0.0734**	**443,869**	**591,709**
Atlantic	33,779	26	5.12	0.4019	907	2.867	0.3344	14,628	0.3731	7,523	30,764
MedW	582,591	249	4.34	0.2992	15,405	1.616	0.1631	105,555	0.1420	81,851	144,335
MedC	606,729	289	2.99	0.1648	18,443	1.567	0.1212	81,771	0.1117	67,708	105,882
Adriatic	135,785	207	8.04	0.2793	4,033	5.132	1.0466	178,877	0.1347	141,236	241,525
MedE	657,452	196	7.03	0.2035	18,895	1.037	0.1495	115,746	0.1543	89,413	162,752
Total	**2,012,329**	**958**	**5.33**	**0.1276**	**56,718**	**1.689**	**0.2162**	**493,695**	**0.0734**	**443,869**	**591,709**

Table 38. Comparison of results between strip and model-based analysis.

Species	n groups	n animals	mean group size	CV mean group size	Design-based					Model-based				
					Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval		Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Cory shearwater	666	1895	2.85	0.1482	0.08216	165,669	0.3278	109,650	250,307	0.0561	128,192	0.2832	116,476	167,641
Large shearwaters	878	2522	2.89	0.1274	0.11436	230,580	0.2712	163,440	325,301	0.0957	218,647	0.1628	200,761	280,881
Small shearwaters	253	1736	6.88	0.1609	0.05856	118,067	0.3591	75,291	185,148	0.0584	133,468	0.2393	106,607	206,853
All shearwaters	1131	4258	3.78	0.1008	0.17291	348,648	0.1643	282,383	430,461	0.1459	333,270	0.1257	305,384	402,446
Gannet	39	139	3.56		0.00505	10,192	2.5630	1,623	64,022					
Terns	99	142	1.43	0.0618	0.00769	15,515	1.3144	4,254	56,580	0.0059	13,469	0.6748	11,731	61,959
Storm petrel	30	41	1.37		0.00172	3,474	3.4517	440	27,421					
Small gulls	306	1239	4.05	0.2108	0.14366	289,672	1.4354	73,898	1,135,477	0.0497	113,532	0.1197	96,801	156,959
Large gulls	958	5107	5.33	0.1276	0.28659	577,854	0.1840	456,534	731,414	0.2162	493,695	0.0734	443,869	591,709

Turtles

Strip transect results

Table 39 shows the results of the strip transect analysis for turtles. The extrapolation areas have been included to be more comparable to the spatial models results.

Table 40. shows the results of abundance estimates for the model-based analysis for each species or group.

Table 39. Results of the strip transect analysis for sea turtles.

Stratum	Area	n groups	n animals	mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33720	18	18	1.00	873	0.021	0.03231	1,091	0.7347	467	2,550
Alboran	28071	57	70	1.23	765	0.075	0.18466	8,872	0.2919	6,133	12,836
SWMed	279415	675	699	1.04	6,895	0.098	0.22649	77,254	0.0703	70,560	84,583
NWMed	134760	320	325	1.02	4,471	0.072	0.16929	22,957	0.1160	19,772	26,655
PelagosW	56756	5	5	1.00	1,036	0.005	0.00868	493	2.6596	76	3,186
PelagosE	31076	45	45	1.00	2,261	0.020	0.03647	1,133	0.4834	627	2,048
Tyrrhenian	231298	1214	1304	1.07	7,081	0.171	0.37449	86,553	0.0584	80,267	93,332
SCMed	152961	571	659	1.15	4,592	0.124	0.28278	43,102	0.0889	38,435	48,337
Adriatic	135783	416	444	1.07	3,816	0.109	0.25169	34,176	0.1302	28,907	40,406
Ionian	185926	297	332	1.12	10,488	0.028	0.08472	30,388	0.2509	22,085	41,812
Aegean	191150	49	63	1.29	5,490	0.009	0.02638	5,043	0.7765	2,076	12,246
NEMed	161669	13	15	1.15	4,811	0.003	0.00624	1,010	2.0681	191	5,342
EMed	107687	8	8	1.00	2,833	0.003	0.01023	1,528	2.5641	243	9,601
Total	**1902749**	**3688**	**3987**	**1.08**	**55,412**	**0.067**	**0.16343**	**329,529**	**0.0482**	**309,652**	**350,683**
Atlantic	33720	18	18	1.00	873	0.021	0.03231	1,091	0.7347	467	2,550
MedW	499002	1097	1139	1.04	14,393	0.076	0.17514	102,037	0.0635	94,013	110,746
MedC	601262	2054	2267	1.10	18,011	0.114	0.27467	166,648	0.0519	155,844	178,201
Adriatic	135783	416	444	1.07	3,816	0.109	0.25169	34,176	0.1302	28,907	40,406
MedE	632983	103	119	1.16	18,319	0.006	0.02030	13,345	0.6639	6,114	29,128
Total	**1902749**	**3688**	**3987**	**1.08**	**55,412**	**0.067**	**0.16343**	**329,529**	**0.0482**	**309,652**	**350,683**

Table 40. Results of the model-based analysis for sea turtles.

Stratum	Area	n groups	mean group size	CV mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33,779	18	1.00	0.0000	907	1.985	0.0515	2,252	0.2800	1,314	3,997
Alboran	48,047	58	1.24	0.1289	874	6.639	0.1616	10,220	0.1554	7,742	14,134
SWMed	341,085	705	1.04	0.0074	7,791	9.049	0.2276	86,874	0.0593	77,923	98,688
NWMed	135,613	357	1.01	0.0061	5,079	7.028	0.1947	31,224	0.0661	27,681	35,905
Pelagos	87,620	60	1.00	0.0000	3,834	1.565	0.0490	5,443	0.1013	4,515	6,635
Tyrrhenian	231,122	1,098	1.08	0.0087	7,008	15.668	0.3436	89,630	0.0492	81,892	99,306
SCMed	152,422	609	1.15	0.0165	4,949	12.305	0.3149	56,886	0.0589	51,321	64,393
Adriatic	135,785	510	1.06	0.0111	4,033	12.644	0.2182	37,284	0.0825	31,858	44,421
Ionian	358,703	310	1.11	0.0186	10,728	2.890	0.0707	28,987	0.0729	25,612	33,958
Aegean	191,148	50	1.28	0.1447	5,826	0.858	0.0179	4,351	0.1566	3,270	5,957
NEMed	161,732	14	1.14	0.1250	5,016	0.279	0.0089	1,603	0.2306	1,043	2,565
EMed	149,321	9	1.00	0.0000	3,111	0.289	0.0046	732	0.4443	359	1,801
Total	**2,012,329**	**3,692**	**1.08**	**0.0058**	**56,718**	**6.509**	**0.1503**	**343,321**	**0.0298**	**328,082**	**368,030**
Atlantic	33,779	18	1.00	0.0000	907	1.985	0.0515	2,252	0.2800	1,314	3,997
MedW	582,591	1,100	1.04	0.0096	15,405	7.141	0.1921	124,314	0.0515	112,991	139,517
MedC	606,729	1,962	1.11	0.0077	18,443	10.638	0.2517	169,728	0.0375	159,897	185,284
Adriatic	135,785	510	1.06	0.0111	4,033	12.644	0.2182	37,284	0.0825	31,858	44,421
MedE	657,452	103	1.16	0.0799	18,895	0.545	0.0143	11,105	0.1038	9,355	13,938
Total	**2,012,329**	**3,692**	**1.08**	**0.0058**	**56,718**	**6.509**	**0.1503**	**343,321**	**0.0298**	**328,082**	**368,030**

Fish and elasmobranchs

Designed based results

Table 41 shows the results of the strip transect analysis for sunfish. The extrapolation areas have been included to be more comparable to the spatial models results. Tables 42 to 49 show the results of the design-based analysis for each species or group.

Table 41. Results of the strip transect analysis for sunfish.

Stratum	Area	n groups	n animals	mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33720	13	13	1.00	873	0.015	0.03132	1,058	1.2216	308	3,635
Alboran	28071	19	19	1.00	765	0.025	0.06389	3,070	0.6852	1,377	6,841
SWMed	279415	40	46	1.15	6,895	0.006	0.01353	4,614	0.9332	1,660	12,826
NWMed	134760	164	186	1.13	4,471	0.037	0.09916	13,448	0.2199	10,156	17,805
PelagosW	56756	44	48	1.09	2,261	0.019	0.04064	1,262	0.4836	698	2,282
PelagosE	31076	15	16	1.07	1,036	0.014	0.02819	1,599	1.0822	513	4,988
Tyrrhenian	231298	8	8	1.00	7,081	0.001	0.00204	471	4.3386	51	4,393
SCMed	152961	9	10	1.11	4,592	0.002	0.00318	485	2.5517	78	3,038
Adriatic	135783	10	10	1.00	3,816	0.003	0.00645	876	3.2703	116	6,638
Ionian	185926	6	6	1.00	10,488	0.001	0.00101	363	6.6217	29	4,513
Aegean	191150	8	8	1.00	5,490	0.001	0.00220	420	3.1417	57	3,086
NEMed	161669	3	3	1.00	4,811	0.001	0.00262	424	9.8210	27	6,724
EMed	107687	3	5	1.67	2,833	0.001	0.00303	452	6.2853	38	5,430
Total	**1902749**	**342**	**378**	**1.11**	**55,412**	**0.006**	**0.01493**	**30,097**	**0.3648**	**19,065**	**47,510**
Atlantic	33720	13	13	1.00	873	0.015	0.03132	1,058	1.2216	308	3,635
MedW	499002	267	299	1.12	14,393	0.019	0.04786	27,881	0.2339	20,695	37,562
MedC	601262	38	40	1.05	18,011	0.002	0.00392	2,381	1.5619	567	10,005
Adriatic	135783	10	10	1.00	3,816	0.003	0.00645	876	3.2703	116	6,638
MedE	632983	14	16	1.14	18,319	0.001	0.00173	1,137	4.1730	125	10,312
Total	**1902749**	**342**	**378**	**1.11**	**55,412**	**0.006**	**0.01493**	**30,097**	**0.3648**	**19,065**	**47,510**

Table 42. Results of the design-based analysis for sharks (all identified and unidentified species pooled together).

Stratum	Area	n groups	mean group size	exp. group size	CV exp. group size	Effort (km)	Enc. Rate groups (x100km)	CV (%) Enc. rate groups	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33720	4	1.50	1.51	0.2528	873	0.458	0.4940	0.0163	550	0.5446	199	1,522
Alboran	28071	7	1.29	1.29	0.2732	765	0.915	0.3963	0.0344	966	0.4441	413	2,259
SWMed	279415	12	1.00	1.00	0.0000	6892	0.174	0.3045	0.0044	1,241	0.3230	668	2,307
NWMed	134760	61	1.26	1.26	0.0787	4471	1.364	0.2162	0.0500	6,740	0.2613	4,057	11,196
PelagosW	56756	1	1.00	1.00	0.0000	2261	0.044	0.9979	0.0011	63	1.0013	12	332
PelagosE	31076	0	0.00	0.00	0.0000	1036	0.000	0.0000	0.0000	0	0.0000	0	0
Tyrrhenian	231298	8	7.25	7.29	6.1557	7080	0.113	0.4902	0.0239	5,537	0.8711	1,264	24,259
SCMed	152961	23	1.17	1.17	0.0778	4583	0.502	0.2249	0.0145	2,224	0.2436	1,386	3,568
Adriatic	135783	18	2.11	2.01	0.3967	3816	0.472	0.3188	0.0264	3,582	0.3982	1,682	7,627
IonianC	185926	6	2.00	2.00	0.4729	5302	0.113	0.6178	0.0066	1,231	0.6208	399	3,800
IonianE	172477	1	1.00	1.00	0.0000	5186	0.019	0.0000	0.0006	97	1.0068	19	506
Aegean	191150	2	1.50	1.50	0.3542	5490	0.036	0.7059	0.0016	306	0.7468	82	1,133
NEMed	161669	1	1.00	1.00	0.0000	4809	0.021	0.9967	0.0006	98	0.9991	19	509
EMed	107687	0	0.00	0.00	0.0000	2833	0.000	0.0000	0.0000	0	0.0000	0	0
Total	**1902749**	**144**	**0.23**	**1.72**	**0.3604**	**55398**	**0.269**	**0.1286**	**0.0119**	**22,634**	**0.2468**	**14,039**	**36,489**
Atlantic	33720	4	1.50	1.51	0.1671	873	0.458	0.4940	0.0163	550	0.5446	199	1,522
MedW	499002	81	1.22	1.23	0.0561	14390	0.563	0.1862	0.0197	9,817	0.2303	6,282	15,340
MedC	601262	37	2.62	2.78	0.5237	18002	0.206	0.2047	0.0151	9,059	0.5540	3,281	25,012
Adriatic	135783	18	2.11	2.01	0.1971	3816	0.472	0.3188	0.0264	3,582	0.3982	1,682	7,627
MedE	632983	4	1.25	1.25	0.1733	18317	0.022	0.4995	0.0008	505	0.5331	189	1,349
Total	**1902749**	**144**	**0.23**	**1.70**	**0.2066**	**55398**	**0.269**	**0.1286**	**0.0124**	**23,512**	**0.2472**	**14,580**	**37,915**

Table 43. Results of the design-based analysis for blue sharks

Stratum	Area	n groups	mean group size	exp. group size	CV exp. group size	Effort (km)	Enc. Rate groups (x100km)	CV (%) Enc. rate groups	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33720	0	0.00	0.00	0.0000	873	0.000	0.0000	0.0000	0	0.0000	0	0
Alboran	28071	1	1.00	1.00	0.0000	765	0.131	0.9775	0.0038	107	0.9799	21	556
SWMed	279415	0	0.00	0.00	0.0000	6892	0.000	0.0000	0.0000	0	0.0000	0	0
NWMed	134760	19	1.00	1.00	0.0000	4471	0.425	0.2367	0.0123	1,652	0.2464	1,023	2,669
PelagosW	56756	0	0.00	0.00	0.0000	2261	0.000	0.0000	0.0000	0	0.0000	0	0
PelagosE	31076	0	0.00	0.00	0.0000	1036	0.000	0.0000	0.0000	0	0.0000	0	0
Tyrrhenian	231298	0	0.00	0.00	0.0000	7080	0.000	0.0000	0.0000	0	0.0000	0	0
SCMed	152961	1	1.00	1.00	0.0000	4583	0.022	0.9931	0.0006	98	0.9956	19	501
Adriatic	135783	7	1.29	1.29	0.2651	3816	0.183	0.3726	0.0069	936	0.4327	414	2,118
IonianC	185926	5	1.40	1.40	0.1501	5302	0.094	0.6583	0.0039	718	0.6522	222	2,326
IonianE	172477	1	1.00	1.00	0.0000	5186	0.019	0.0000	0.0006	97	1.0068	19	506
Aegean	191150	2	1.50	1.50	0.3542	5490	0.036	0.7059	0.0016	306	0.7468	82	1,133
NEMed	161669	0	0.00	0.00	0.0000	4809	0.000	0.0000	0.0000	0	0.0000	0	0
EMed	107687	0	0.00	0.00	0.0000	2833	0.000	0.0000	0.0000	0	0.0000	0	0
Total	**1902749**	**36**	**1.18**	**1.15**	**0.0729**	**55398**	**0.070**	**0.1916**	**0.0021**	**3,914**	**0.2111**	**2,598**	**5,898**
Atlantic	33720	0	0.00	0.00	0.0000	873	0.000	0.0000	0.0000	0	0.0000	0	0
MedW	499002	20	1.00	1.00	0.0000	14390	0.139	0.2459	0.0040	2,003	0.2556	1,222	3,282
MedC	601262	6	1.33	1.33	0.1021	18002	0.033	0.5746	0.0013	781	0.5874	268	2,275
Adriatic	135783	7	1.29	1.29	0.2062	3816	0.183	0.3726	0.0069	936	0.4327	414	2,118
MedE	632983	3	1.33	1.33	0.2043	18317	0.016	0.5779	0.0006	404	0.6165	133	1,232
Total	**1902749**	**36**	**0.21**	**1.14**	**0.0605**	**55398**	**0.070**	**0.1916**	**0.0022**	**4,125**	**0.2102**	**2,744**	**6,201**

Table 44. Results of the design-based analysis for all rays (all identified and unidentified species).

Stratum	Area	n groups	mean group size	exp. group size	CV exp. group size	Effort (km)	Enc. Rate groups (x100km)	CV (%) Enc. rate groups	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33720	5	1.00	1.00	0.0000	873	0.573	0.8398	0.0137	461	0.8671	103	2,061
Alboran	28071	3	1.67	1.67	0.5493	765	0.392	0.5202	0.0129	362	0.6156	116	1,129
SWMed	279415	47	1.77	1.77	0.2295	6892	0.682	0.1789	0.0299	8,344	0.2354	5,283	13,177
NWMed	134760	54	1.52	1.51	0.2797	4471	1.208	0.1621	0.0402	5,423	0.2338	3,438	8,555
PelagosW	56756	14	3.50	3.54	1.4593	2261	0.619	0.2371	0.0505	2,868	0.4997	1,122	7,329
PelagosE	31076	7	1.00	1.00	0.0000	1036	0.676	0.3891	0.0158	492	0.3750	237	1,021
Tyrrhenian	231298	66	1.39	1.39	0.0925	7080	0.932	0.2895	0.0272	6,288	0.3052	3,497	11,306
SCMed	152961	19	1.32	1.35	0.2046	4583	0.415	0.3398	0.0125	1,905	0.3947	900	4,035
Adriatic	135783	30	1.13	1.14	0.0629	3816	0.786	0.3377	0.0213	2,892	0.3307	1,534	5,455
IonianC	185926	4	1.00	1.00	0.0000	5302	0.075	0.6129	0.0016	295	0.6040	98	888
IonianE	172477	1	1.00	1.00	0.0000	5186	0.019	0.0000	0.0005	83	0.9829	16	418
Aegean	191150	8	4.75	4.58	3.3728	5490	0.146	0.3963	0.0174	3,327	0.7914	843	13,124
NEMed	161669	2	1.00	1.00	0.0000	4809	0.042	0.7056	0.0009	150	0.7111	42	531
EMed	107687	1	2.00	2.00	0.0000	2833	0.035	1.0064	0.0014	150	1.0079	28	798
Total	**1902749**	**261**	**0.14**	**1.64**	**0.1619**	**55398**	**0.475**	**0.1049**	**0.0174**	**33,040**	**0.1401**	**25,135**	**43,431**
Atlantic	33720	5	1.00	1.00	0.0000	873	0.573	0.8398	0.0137	461	0.8671	103	2,061
MedW	499002	118	1.86	1.86	0.1296	14390	0.820	0.1087	0.0354	17,681	0.1716	12,654	24,706
MedC	601262	96	1.33	1.34	0.0593	18002	0.533	0.2162	0.0152	9,164	0.2352	5,812	14,450
Adriatic	135783	30	1.13	1.14	0.0554	3816	0.786	0.3377	0.0213	2,892	0.3307	1,534	5,455
MedE	632983	12	3.58	3.57	0.6597	18317	0.066	0.3105	0.0058	3,678	0.7115	1,047	12,921
Total	**1902749**	**261**	**0.14**	**1.66**	**0.1018**	**55398**	**0.475**	**0.1049**	**0.0178**	**33,877**	**0.1414**	**25,709**	**44,640**

Table 45. Results of the design-based analysis for giant devil ray.

Stratum	Area	n groups	mean group size	exp. group size	CV exp. group size	Effort (km)	Enc. Rate groups (x100km)	CV (%) Enc. rate groups	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33720	5	1.00	1.00	0.0000	873	0.573	0.8398	0.0137	461	0.8671	103	2,061
Alboran	28071	3	1.67	1.67	0.5493	765	0.392	0.5202	0.0129	362	0.6156	116	1,129
SWMed	279415	46	1.78	1.79	0.2404	6892	0.667	0.1794	0.0295	8,243	0.2342	5,231	12,990
NWMed	134760	44	1.61	1.61	0.3473	4471	0.984	0.1673	0.0342	4,613	0.2613	2,776	7,667
PelagosW	56756	13	3.69	3.71	1.5455	2261	0.575	0.2491	0.0497	2,818	0.5084	1,087	7,308
PelagosE	31076	7	1.00	1.00	0.0000	1036	0.676	0.3891	0.0158	492	0.3750	237	1,021
Tyrrhenian	231298	63	1.41	1.41	0.0951	7080	0.890	0.3030	0.0263	6,078	0.3155	3,317	11,136
SCMed	152961	1	1.00	1.00	0.0000	4583	0.022	1.0016	0.0004	66	1.0031	13	342
Adriatic	135783	23	1.13	1.12	0.0584	3816	0.603	0.4301	0.0147	1,991	0.4313	882	4,495
IonianC	185926	1	1.00	1.00	0.0000	5302	0.019	0.9966	0.0005	87	0.9982	17	451
IonianE	172477	1	1.00	1.00	0.0000	5186	0.019	0.0000	0.0005	83	0.9829	16	418
Aegean	191150	2	1.00	1.00	0.0000	5490	0.036	0.7037	0.0008	155	0.7091	44	546
NEMed	161669	1	1.00	1.00	0.0000	4809	0.021	0.9981	0.0005	84	0.9996	16	433
EMed	107687	0	0.00	0.00	0.0000	2833	0.000	0.0000	0.0000	0	0.0000	0	0
Total	**1902749**	**210**	**0.14**	**1.60**	**0.1294**	**55398**	**0.381**	**0.1224**	**0.0134**	**25,534**	**0.1396**	**19,442**	**33,533**
Atlantic	33720	5	1.00	1.00	0.0000	873	0.573	0.8398	0.0137	461	0.8671	103	2,061
MedW	499002	106	1.94	1.95	0.1372	14390	0.737	0.1104	0.0333	16,595	0.1790	11,709	23,519
MedC	601262	72	1.36	1.35	0.0650	18002	0.400	0.2731	0.0115	6,911	0.2905	3,952	12,083
Adriatic	135783	23	1.13	1.12	0.0523	3816	0.603	0.4301	0.0147	1,991	0.4313	882	4,495
MedE	632983	4	1.00	1.00	0.0000	18317	0.022	0.4960	0.0005	326	0.5001	129	825
Total	**1902749**	**210**	**0.14**	**1.62**	**0.0905**	**55398**	**0.381**	**0.1224**	**0.0138**	**26,284**	**0.1440**	**19,846**	**34,810**

Table 46. Results of the design-based analysis for small rays (rays not identified as giant devil ray).

Stratum	Area	n groups	mean group size	exp. group size	CV exp. group size	Effort (km)	Enc. Rate groups (x100km)	CV (%) Enc. rate groups	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33720	0	0.00	0.00	0.0000	873	0.000	0.0000	0.0000	0	0.0000	0	0
Alboran	28071	0	0.00	0.00	0.0000	765	0.000	0.0000	0.0000	0	0.0000	0	0
SWMed	279415	1	1.00	1.00	0.0000	6892	0.015	0.9997	0.0004	101	1.0012	20	520
NWMed	134760	10	1.10	1.10	0.0569	4471	0.224	0.5614	0.0060	810	0.6032	269	2,435
PelagosW	56756	1	1.00	1.00	0.0000	2261	0.044	1.0014	0.0009	50	1.0029	9	260
PelagosE	31076	0	0.00	0.00	0.0000	1036	0.000	0.0000	0.0000	0	0.0000	0	0
Tyrrhenian	231298	3	1.00	1.00	0.0000	7080	0.042	0.5729	0.0009	210	0.5783	73	605
SCMed	152961	18	1.33	1.37	0.2117	4583	0.393	0.3465	0.0120	1,839	0.4044	854	3,962
Adriatic	135783	7	1.14	1.18	0.1601	3816	0.183	0.3833	0.0066	901	0.5031	354	2,293
IonianC	185926	3	1.00	1.00	0.0000	5302	0.057	0.7491	0.0011	208	0.7511	55	778
IonianE	172477	0	0.00	0.00	0.0000	5186	0.000	0.0000	0.0000	0	0.0000	0	0
Aegean	191150	6	6.00	5.55	4.3228	5490	0.109	0.4749	0.0166	3,171	0.8295	763	13,175
NEMed	161669	1	1.00	1.00	0.0000	4809	0.021	1.0031	0.0004	66	1.0045	13	346
EMed	107687	1	2.00	2.00	0.0000	2833	0.035	1.0064	0.0014	150	1.0079	28	798
Total	**1902749**	**51**	**0.36**	**1.82**	**0.6112**	**55398**	**0.094**	**0.1933**	**0.0039**	**7,506**	**0.3792**	**3,652**	**15,431**
Atlantic	33720	0	0.00	0.00	0.0000	873	0.000	0.0000	0.0000	0	0.0000	0	0
MedW	499002	12	1.08	1.09	0.0493	14390	0.083	0.4837	0.0022	1,086	0.5288	410	2,881
MedC	601262	24	1.25	1.28	0.1317	18002	0.133	0.2910	0.0037	2,254	0.3456	1,166	4,357
Adriatic	135783	7	1.14	1.18	0.1361	3816	0.183	0.3833	0.0066	901	0.5031	354	2,293
MedE	632983	8	4.88	4.77	0.7241	18317	0.044	0.3966	0.0053	3,352	0.7792	867	12,959
Total	**1902749**	**51**	**0.36**	**1.80**	**0.3296**	**55398**	**0.094**	**0.1933**	**0.0040**	**7,593**	**0.3741**	**3,733**	**15,447**

Table 47. Results of the design-based analysis for tuna fish.

Stratum	Area	n groups	mean group size	exp. group size	CV exp. group size	Effort (km)	Enc. Rate groups (x100km)	CV (%) Enc. rate groups	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33720	0	0.00	0.00	0.0000	873	0.000	0.0000	0.0000	0	0.0000	0	0
Alboran	28071	1	1.00	1.00	0.0000	765	0.131	1.0138	0.0015	42	1.9808	3	501
SWMed	279415	13	89.00	69.78	59.2466	6892	0.189	0.2730	0.2631	73,525	0.9323	15,557	347,491
NWMed	134760	21	156.90	166.46	77.6726	4471	0.470	0.3018	1.8067	243,467	0.5337	90,500	654,983
PelagosW	56756	8	141.38	148.03	123.221	2261	0.354	0.3957	1.3416	76,146	0.9083	16,298	355,762
PelagosE	31076	1	100.00	100.00	0.0000	1036	0.097	0.9861	0.1948	6,054	0.9890	1,146	31,965
Tyrrhenian	231298	19	1.00	1.00	0.0000	7080	0.268	0.2446	0.0057	1,321	0.2481	817	2,135
SCMed	152961	3	2.00	2.00	0.4748	4583	0.065	0.5703	0.0031	473	0.6237	153	1,464
Adriatic	135783	86	1.15	1.16	0.0772	3816	2.253	0.1574	0.0534	7,256	0.1913	4,995	10,540
IonianC	185926	10	8.00	8.35	5.4130	5302	0.189	0.4817	0.0402	7,471	0.8845	1,665	33,529
IonianE	172477	0	0.00	0.00	0.0000	5186	0.000	0.0000	0.0000	0	0.0000	0	0
Aegean	191150	3	36.67	37.27	2.8206	5490	0.055	0.7475	0.0501	9,585	0.8156	2,351	39,082
NEMed	161669	1	1.00	1.00	0.0000	4809	0.021	0.9984	0.0005	79	1.0058	15	412
EMed	107687	0	0.00	0.00	0.0000	2833	0.000	0.0000	0.0000	0	0.0000	0	0
Total	**1902749**	**166**	**0.35**	**34.97**	**13.0111**	**55398**	**0.307**	**0.1131**	**0.2236**	**425,418**	**0.3840**	**205,061**	**882,570**
Atlantic	33720	0	0.00	0.00	0.0000	873	0.000	0.0000	0.0000	0	0.0000	0	0
MedW	499002	43	129.86	134.44	0.3670	14390	0.299	0.1892	0.8983	448,267	0.4203	203,017	989,786
MedC	601262	33	6.21	6.26	0.5225	18002	0.183	0.2119	0.0261	15,679	0.5892	5,370	45,782
Adriatic	135783	86	1.15	1.16	0.0664	3816	2.253	0.1574	0.0534	7,256	0.1913	4,995	10,540
MedE	632983	4	27.75	28.51	0.3239	18317	0.022	0.6128	0.0152	9,593	0.8074	2,388	38,548
Total	**1902749**	**166**	**0.35**	**38.71**	**0.3786**	**55398**	**0.307**	**0.1131**	**0.2527**	**480,796**	**0.3931**	**228,409**	**1,012,062**

Table 48. Results of the design-based analysis for swordfish.

Stratum	Area	n groups	mean group size	exp. group size	CV exp. group size	Effort (km)	Enc. Rate groups (x100km)	CV (%) Enc. rate groups	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33720	0	0.00	0.00	0.0000	873	0.000	0.0000	0.0000	0	0.0000	0	0
Alboran	28071	8	1.00	1.00	0.0000	765	1.046	0.4610	0.0232	651	0.4828	260	1,626
SWMed	279415	41	1.05	1.06	0.0361	6892	0.595	0.2676	0.0130	3,622	0.2806	2,107	6,226
NWMed	134760	72	1.06	1.06	0.0287	4471	1.610	0.2226	0.0410	5,521	0.2187	3,602	8,462
PelagosW	56756	18	1.11	1.13	0.0835	2261	0.796	0.3266	0.0210	1,190	0.3210	639	2,217
PelagosE	31076	8	1.00	1.00	0.0000	1036	0.772	0.5387	0.0201	625	0.5542	220	1,772
Tyrrhenian	231298	18	1.11	1.11	0.0729	7080	0.254	0.2391	0.0069	1,594	0.2536	976	2,604
SCMed	152961	6	1.67	1.65	0.1829	4583	0.131	0.5141	0.0052	799	0.5342	297	2,146
Adriatic	135783	37	1.03	1.03	0.0300	3816	0.969	0.2350	0.0209	2,839	0.2289	1,819	4,431
IonianC	185926	10	1.20	1.19	0.1258	5302	0.189	0.3314	0.0056	1,037	0.3500	530	2,028
IonianE	172477	5	1.40	1.39	0.2223	5186	0.096	0.0000	0.0030	517	0.4780	212	1,264
Aegean	191150	10	1.60	1.63	0.3976	5490	0.182	0.2990	0.0071	1,362	0.3982	640	2,898
NEMed	161669	0	0.00	0.00	0.0000	4809	0.000	0.0000	0.0000	0	0.0000	0	0
EMed	107687	0	0.00	0.00	0.0000	2833	0.000	0.0000	0.0000	0	0.0000	0	0
Total	**1902749**	**233**	**0.11**	**1.11**	**0.0288**	**55398**	**0.422**	**0.1087**	**0.0104**	**19,756**	**0.1100**	**15,931**	**24,499**
Atlantic	33720	0	0.00	0.00	0.0000	873	0.000	0.0000	0.0000	0	0.0000	0	0
MedW	499002	139	1.06	1.06	0.0204	14390	0.966	0.1515	0.0235	11,709	0.1564	8,629	15,889
MedC	601262	42	1.19	1.18	0.0560	18002	0.233	0.1836	0.0068	4,113	0.1989	2,794	6,053
Adriatic	135783	37	1.03	1.03	0.0292	3816	0.969	0.2350	0.0209	2,839	0.2289	1,819	4,431
MedE	632983	15	1.53	1.56	0.1812	18317	0.082	0.2548	0.0030	1,889	0.3214	1,021	3,495
Total	**1902749**	**233**	**0.11**	**1.11**	**0.0255**	**55398**	**0.422**	**0.1087**	**0.0108**	**20,550**	**0.1119**	**16,510**	**25,577**

Table 49. Results of the design-based analysis for small fish.

Stratum	Area	n groups	mean group size	exp. group size	CV exp. group size	Effort (km)	Enc. Rate groups (x100km)	CV (%) Enc. rate groups	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33720	0	0.00	0.00	0.0000	873	0.000	0.0000	0.0000	0	0.0000	0	0
Alboran	28071	0	0.00	0.00	0.0000	765	0.000	0.0000	0.0000	0	0.0000	0	0
SWMed	279415	17	22.53	15.81	8.7761	6892	0.247	0.3200	0.0962	26,885	0.5604	9,613	75,193
NWMed	134760	1	50.00	50.00	0.0000	4471	0.022	0.9951	0.0306	4,118	1.0019	793	21,401
PelagosW	56756	0	0.00	0.00	0.0000	2261	0.000	0.0000	0.0000	0	0.0000	0	0
PelagosE	31076	7	342.86	337.53	130.709	1036	0.676	0.6923	6.1725	191,817	0.5552	67,630	544,047
Tyrrhenian	231298	5	1.00	1.00	0.0000	7080	0.071	0.5291	0.0015	353	0.5514	128	973
SCMed	152961	9	1.00	1.00	0.0000	4583	0.196	0.4559	0.0047	713	0.4692	296	1,719
Adriatic	135783	33	1.00	1.00	0.0000	3816	0.865	0.2445	0.0203	2,754	0.2523	1,688	4,492
IonianC	185926	8	1.25	1.18	0.1870	5302	0.151	0.4540	0.0046	853	0.4522	364	2,000
IonianE	172477	0	0.00	0.00	0.0000	5186	0.000	0.0000	0.0000	0	0.0000	0	0
Aegean	191150	55	5.00	4.55	1.7093	5490	1.002	0.1759	0.1169	22,346	0.4056	10,367	48,165
NEMed	161669	7	2.29	2.14	0.5114	4809	0.146	0.4682	0.0084	1,354	0.5902	460	3,982
EMed	107687	2	1.50	1.44	0.3529	2833	0.071	0.7113	0.0021	231	0.7329	63	855
Total	**1902749**	**144**	**0.46**	**19.96**	**8.2061**	**55398**	**0.260**	**0.1172**	**0.1321**	**251,426**	**0.4306**	**109,849**	**575,472**
Atlantic	33720	0	0.00	0.00	0.0000	873	0.000	0.0000	0.0000	0	0.0000	0	0
MedW	499002	18	24.06	17.90	0.4875	14390	0.125	0.3106	0.0556	27,737	0.4963	11,036	69,707
MedC	601262	29	83.59	89.89	0.4843	18002	0.161	0.2736	0.3583	215,430	0.5836	74,441	623,445
Adriatic	135783	33	1.00	1.00	0.0000	3816	0.865	0.2445	0.0203	2,754	0.2523	1,688	4,492
MedE	632983	64	4.59	4.19	0.3505	18317	0.349	0.1712	0.0376	23,778	0.3868	11,424	49,493
Total	**1902749**	**144**	**0.46**	**21.80**	**0.4461**	**55398**	**0.260**	**0.1172**	**0.1417**	**269,698**	**0.4710**	**112,039**	**649,215**

Model based results

Table 50 shows the parameters and selected covariates for the density surface modeling for each species or group of species.
Tables 51 to 56 show the results of abundance estimates for the model-based analysis for each species or group. Table 57 show a comparison of results between the strip and model-based analysis.

Table 50. Results of the model-based analysis for all sharks.

Stratum	Area	n groups	mean group size	CV mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33779	4	1.50	0.1925	907	0.441	0.0192	649	0.6986	342	4234
Alboran	48047	7	1.29	0.2222	874	0.801	0.0117	563	0.5450	375	2683
SWMed	341085	13	1.00	0.0000	7791	0.167	0.0120	4,099	0.2458	4659	11531
NWMed	135613	62	1.26	0.0752	5079	1.221	0.0484	6,561	0.2618	7039	18903
Pelagos	87620	3	1.00	0.0000	3834	0.078	0.0066	578	0.3409	524	1921
Tyrrhenian	231122	8	7.25	0.8425	7008	0.114	0.0328	7,591	0.3025	8587	20158
SCMed	152422	23	1.17	0.0688	4949	0.465	0.0156	2,370	0.3364	2277	8415
Adriatic	135785	18	2.11	0.2326	4033	0.446	0.0307	4,169	0.3273	4458	14455
Ionian	358703	7	1.86	0.2979	10728	0.065	0.0043	1,535	0.3303	1557	5086
Aegean	191148	3	1.33	0.2500	5826	0.051	0.0023	433	0.5534	284	2092
NEMed	161732	1	1.00	0.0000	5016	0.020	0.0003	42	0.0000	16	322
SEMed											
EMed	149321	0	0.00	0.0000	3111	0.000	0.0001	10	0.0000	0	84
Total	**2012329**	**145**	**1.70**	**0.2037**	**56718**	**0.256**	**0.0139**	**27,934**	**0.2590**	**39820**	**68739**
Atlantic	33779	4	1.50	0.1925	907	0.441	0.0192	649	0.6986	342	4234
MedW	582591	82	1.22	0.0621	15405	0.532	0.0182	10,616	0.2313	12557	28540
MedC	606729	37	2.62	0.5041	18443	0.201	0.0187	11,368	0.3209	14524	29370
Adriatic	135785	18	2.11	0.2326	4033	0.446	0.0307	4,169	0.3273	4458	14455
MedE	657452	4	1.25	0.2000	18895	0.021	0.0011	691	0.5749	610	4423
Total	**2012329**	**145**	**1.70**	**0.2037**	**56718**	**0.256**	**0.0139**	**27,934**	**0.2590**	**39820**	**68739**

Table 51. Results of the model-based analysis for blue sharks.

Stratum	Area	n groups	mean group size	CV mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33779	0			907	0.000	0.0011	39	0.06	18	70
Alboran	48047	1	1.00	0.0000	874	0.114	0.0015	74	0.06	43	106
SWMed	341085	0			7791	0.000	0.0012	416	0.06	240	577
NWMed	135613	19	1.00	0.0000	5079	0.374	0.0041	562	0.06	345	772
Pelagos	87620	0					0.0000				
Tyrrhenian	231122	0			7008	0.000	0.0011	256	0.06	128	403
SCMed	152422	1	1.00	0.0000	4949	0.020	0.0004	64	0.06	30	115
Adriatic	135785	6	1.33	0.1581	10728	0.056	0.0026	353	0.06	174	575
Ionian	358703	7	1.29	0.2222	4033	0.174	0.0006	211	0.06	104	356
Aegean	191148	2	1.50	0.3333	5826	0.034	0.0007	143	0.06	74	227
NEMed	161732	0			5016	0.000	0.0008	129	0.06	58	234
EMed	149321	0			3111	0.000	0.0002	23	0.06	7	61
Total	**2012329**	**36**	**1.14**	**0.0621**	**56718**	**0.063**	**0.0012**	**2,429**	**0.06**	**1384**	**3545**
Atlantic	33779	0			907	0.000	0.0011	39	0.06	18	70
MedW	582591	20	1.00	0.0000	15405	0.130	0.0020	1,157	0.06	717	1566
MedC	606729	1	1.33	0.1581	18443	0.033	0.0008	499	0.06	245	810
Adriatic	135785	7	1.29	0.2222	4033	0.174	0.0016	211	0.06	104	356
MedE	657452	8	1.33	0.2500	18895	0.016	0.0008	508	0.06	249	836
Total	**2012329**	**36**	**1.14**	**0.0621**	**56718**	**0.063**	**0.0012**	**2,429**	**0.06**	**1384**	**3545**

Table 52. Results of the model-based analysis for all rays.

Stratum	Area	n groups	mean group size	CV mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33779	5	1.00	0.0000	907	0.551	0.0172	581	0.7300	287	4342
Alboran	48047	3	1.67	0.4000	874	0.343	0.0097	468	0.7111	258	3497
SWMed	341085	52	1.79	0.1153	7791	0.667	0.0171	5,825	0.1884	7350	14233
NWMed	135613	57	1.49	0.1521	5079	1.122	0.0396	5,374	0.2063	6768	13582
Pelagos	87620	28	2.25	0.3372	3834	0.730	0.0356	3,122	0.2560	3586	8292
Tyrrhenian	231122	65	1.40	0.0748	7008	0.928	0.0224	5,172	0.1857	6466	12658
SCMed	152422	21	1.29	0.1532	4949	0.424	0.0133	2,025	0.3691	1881	7673
Adriatic	135785	30	1.13	0.0557	4033	0.744	0.0194	2,639	0.3137	2690	8393
Ionian	358703	5	1.00	0.0000	10728	0.047	0.0015	526	0.4279	533	2362
Aegean	191148	8	4.75	0.7598	5826	0.137	0.0087	1,672	0.3962	1577	6467
NEMed	161732	2	1.00	0.0000	5016	0.040	0.0011	180	0.6322	106	1093
EMed	149321	1	2.00	0.0000	3111	0.032	0.0013	192	0.0000	65	1493
Total	**2012329**	**261**	**1.64**	**0.0932**	**56718**	**0.460**	**0.0132**	**26,558**	**0.1524**	**40451**	**61615**
Atlantic	33779	5	1.00	0.0000	907	0.551	0.0172	581	0.7300	287	4342
MedW	582591	119	1.85	0.1204	15405	0.772	0.0216	12,585	0.1689	17261	29705
MedC	606729	98	1.33	0.0616	18443	0.531	0.0135	8,182	0.1682	11252	20643
Adriatic	135785	30	1.13	0.0557	4033	0.744	0.0194	2,639	0.3137	2690	8393
MedE	657452	12	3.58	0.6709	18895	0.064	0.0034	2,247	0.3740	2496	8875
Total	**2012329**	**261**	**1.64**	**0.0932**	**56718**	**0.460**	**0.0132**	**26,558**	**0.1524**	**40451**	**61615**

Table 53. Results of the model-based analysis for Giant Devil Ray.

Stratum	Area	n groups	mean group size	CV mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33779	5	1.00	0.0000	907	0.551	0.0064	216	0.4885	156	882
Alboran	48047	3	1.67	0.4000	874	0.343	0.0044	212	0.4141	177	825
SWMed	341085	51	1.80	0.1162	7791	0.655	0.0248	8,461	0.1572	10615	18244
NWMed	135613	47	1.57	0.1736	5079	0.925	0.0561	7,602	0.1681	9589	16379
Pelagos	87620	26	2.35	0.3474	3834	0.678	0.0303	2,656	0.3179	3259	6457
Tyrrhenian	231122	63	1.41	0.0762	7008	0.899	0.0157	3,636	0.1452	4617	7696
SCMed	152422	1	1.00	0.0000	4949	0.020	0.0009	141	0.0000	129	529
Adriatic	135785	23	1.13	0.0635	4033	0.570	0.0146	1,986	0.2093	2202	4986
Ionian	358703	2	1.00	0.0000	10728	0.019	0.0028	995	0.4458	1085	3747
Aegean	191148	2	1.00	0.0000	5826	0.034	0.0018	349	0.3731	330	1193
NEMed	161732	1	1.00	0.0000	5016	0.020	0.0001	23	0.0000	14	125
EMed	149321	0	0.00	0.0000	3111	0.000	0.0001	8	0.0000	4	62
Total	**2012329**	**210**	**1.61**	**0.0815**	**56718**	**0.370**	**0.0123**	**24,788**	**0.2868**	**34411**	**53650**
Atlantic	33779	5	1.00	0.0000	907	0.551	0.0064	216	0.4885	156	882
MedW	582591	107	1.93	0.1272	15405	0.695	0.0285	16,614	0.1550	21648	34292
MedC	606729	74	1.35	0.0689	18443	0.401	0.0084	5,109	0.1903	6629	11304
Adriatic	135785	23	1.13	0.0635	4033	0.570	0.0146	1,986	0.2093	2202	4986
MedE	657452	4	1.00	0.0000	18895	0.021	0.0011	723	0.4675	758	2815
Total	**2012329**	**210**	**1.61**	**0.0815**	**56718**	**0.370**	**0.0123**	**24,788**	**0.2868**	**34411**	**53650**

Table 54. Results of the model-based analysis for tuna fish.

Stratum	Area	n groups	mean group size	CV mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33779	0	0.00	0.0000	907	0.000	0.0002	8	1.5184	0	66
Alboran	48047	1	1.00	0.0000	874	0.114	0.0106	511	1.0385	61	3540
SWMed	341085	13	89.00	0.6408	7791	0.167	0.1153	39,340	0.4852	18505	101928
NWMed	135613	24	159.04	0.3508	5079	0.472	1.4597	197,953	0.3966	104211	439180
Pelagos	87620	9	136.78	0.7953	3834	0.235	0.4442	38,923	0.6246	14238	124687
Tyrrhenian	231122	19	1.00	0.0000	7008	0.271	0.0123	2,840	0.2974	1939	5775
SCMed	152422	3	2.00	0.2887	4949	0.061	0.0037	564	0.7660	168	2532
Adriatic	135785	86	1.15	0.0667	4033	2.132	0.0534	7,249	0.1726	5787	11075
Ionian	358703	10	8.00	0.5066	10728	0.093	0.0078	2,787	0.5517	1374	8555
Aegean	191148	3	36.67	0.1818	5826	0.051	0.0309	5,907	0.9049	1273	39374
NEMed	161732	1	1.00	0.0000	5016	0.020	0.0018	285	1.0336	29	2310
EMed	149321	0	0.00	0.0000	3111	0.000	0.0001	9	1.2915	0	77
Total	**2012329**	**166**	**36.14**	**0.3126**	**56718**	**0.293**	**0.1416**	**284,879**	**0.3294**	**187505**	**573561**
Atlantic	33779	0	0.00	0.0000	907	0.000	0.0002	8	1.5184	0	66
MedW	582591	43	129.86	0.3123	15405	0.279	0.4349	253,355	0.3302	156991	527470
MedC	606729	33	6.21	0.5166	18443	0.179	0.0332	20,135	0.4514	11174	50470
Adriatic	135785	86	1.15	0.0667	4033	2.132	0.0534	7,249	0.1726	5787	11075
MedE	657452	4	27.75	0.3635	18895	0.021	0.0102	6,698	0.8229	2478	44242
Total	**2012329**	**166**	**36.14**	**0.3126**	**56718**	**0.293**	**0.1416**	**284,879**	**0.3294**	**187505**	**573561**

Table 55. Results of the model-based analysis for swordfish.

Stratum	Area	n groups	mean group size	CV mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33779	0	0.00	0.0000	907	0.000	0.0018	60	0.0000	10	406
Alboran	48047	8	1.00	0.0000	874	0.916	0.0199	957	0.3810	528	2181
SWMed	341085	43	1.05	0.0311	7791	0.552	0.0231	7,869	0.1589	6637	12164
NWMed	135613	73	1.05	0.0254	5079	1.437	0.0374	5,078	0.1672	4228	7901
Pelagos	87620	26	1.08	0.0495	3834	0.678	0.0168	1,469	0.2315	1098	2592
Tyrrhenian	231122	18	1.11	0.0686	7008	0.257	0.0209	4,823	0.1866	3834	7650
SCMed	152422	6	1.67	0.1265	4949	0.121	0.0080	1,218	0.2443	869	2221
Adriatic	135785	37	1.03	0.0263	4033	0.917	0.0152	2,058	0.3402	1458	4818
Ionian	358703	15	1.27	0.0933	10728	0.140	0.0113	4,064	0.1922	3164	6540
Aegean	191148	10	1.60	0.2500	5826	0.172	0.0031	598	0.3637	332	1352
NEMed	161732	0	0.00	0.0000	5016	0.000	0.0007	106	0.0000	42	468
EMed	149321	0	0.00	0.0000	3111	0.000	0.0000	1	0.0000	0	11
Total	**2012329**	**233**	**1.11**	**0.0228**	**56718**	**0.411**	**0.0140**	**28,174**	**0.1059**	**27582**	**38867**
Atlantic	33779	0	0.00	0.0000	907	0.000	0.0018	60	0.0000	10	406
MedW	582591	139	1.06	0.0187	15405	0.902	0.0244	14,201	0.1380	12674	21064
MedC	606729	42	1.19	0.0515	18443	0.228	0.0151	9,177	0.1556	7756	13733
Adriatic	135785	37	1.03	0.0263	4033	0.917	0.0152	2,058	0.3402	1458	4818
MedE	657452	15	1.53	0.1785	18895	0.079	0.0028	1,830	0.3122	1352	3559
Total	**2012329**	**233**	**1.11**	**0.0228**	**56718**	**0.411**	**0.0140**	**28,174**	**0.1059**	**27582**	**38867**

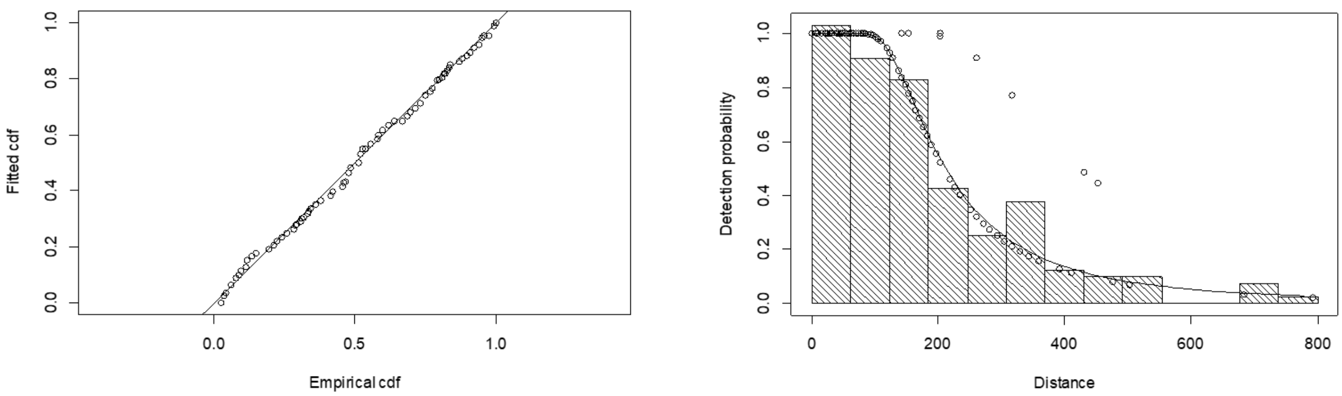
Table 56. Results of the model-based analysis for sunfish.

Stratum	Area	n groups	mean group size	CV mean group size	Effort (km)	Enc. Rate groups (x100km)	Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
Atlantic	33779	13	1.00	0.0000	907	1.434	0.0308	1,346	0.2704	827	2,352
Alboran	48047	19	1.00	0.0000	874	2.175	0.0486	3,072	0.2086	2,070	4,694
SWMed	341085	48	1.13	0.1111	7,791	0.616	0.0155	5,930	0.1264	4,866	7,734
NWMed	135613	166	1.13	0.0256	5,079	3.268	0.0835	13,387	0.0749	11,742	15,560
Pelagos	87620	63	1.08	0.0381	3,834	1.643	0.0421	4,679	0.1121	3,785	5,836
Tyrrhenian	231122	7	1.00	0.0000	7,008	0.100	0.0027	706	0.2829	441	1,270
SCMed	152422	10	1.10	0.0909	4,949	0.202	0.0035	629	0.3505	340	1,294
Adriatic	135785	11	1.00	0.0000	4,033	0.273	0.0058	996	0.2952	594	1,855
Ionian	358703	7	1.00	0.0000	10,728	0.065	0.0020	821	0.2935	511	1,604
Aegean	191148	8	1.00	0.0000	5,826	0.137	0.0024	581	0.3676	304	1,261
NEMed	161732	3	1.00	0.0000	5,016	0.060	0.0018	324	0.4756	157	883
EMed	149321	3	1.67	0.4000	3,111	0.096	0.0030	481	0.5213	228	1,473
Total	**2012329**	**342**	**1.11**	**0.0222**	**56,718**	**0.603**	**0.0136**	**31,131**	**0.0580**	**29,090**	**35,731**
Atlantic	33779	13	1.00	0.0000	907	1.434	0.0308	1,346	0.2704	827	2,352
MedW	582591	268	1.12	0.0268	15,405	1.740	0.0379	24,524	0.0634	22,239	27,864
MedC	606729	38	1.05	0.0349	18,443	0.206	0.0043	2,921	0.1571	2,306	4,225
Adriatic	135785	11	1.00	0.0000	4,033	0.273	0.0058	996	0.2952	594	1,855
MedE	657452	14	1.14	0.1250	18,895	0.074	0.0020	1,575	0.2693	1,130	3,060
Total	**2012329**	**342**	**1.11**	**0.0222**	**56,718**	**0.603**	**0.0136**	**31,131**	**0.0580**	**29,090**	**35,731**

Table 57. Comparison of results between design (or strip transect for sunfish) and model based analysis.

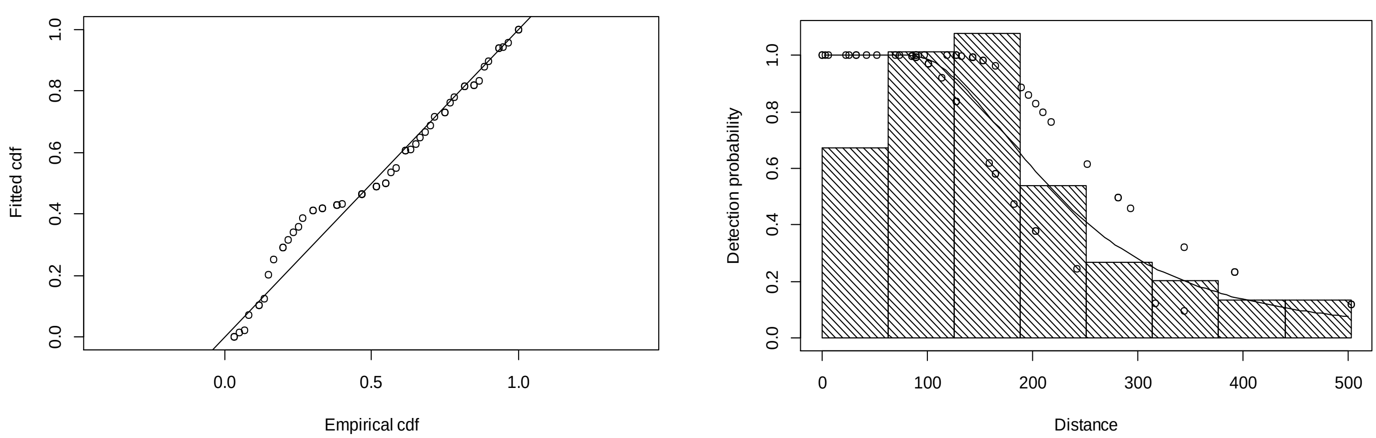
Species	n groups	mean group size	CV exp. Group size	Design-based / Strip transect					Model-based				
				Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval		Density (Anim./ km^2)	Abundance	CV	95% Confidence Interval	
All sharks	144	1.75	0.1992	0.012	22,634	0.2468	14,039	36,489	0.0139	27,934	0.2590	39,820	68,739
Blue sharks	36	1.18	0.0646	0.0021	3,914	0.2111	2,598	5,898	0.0012	2,429	0.0621	1,384	3,545
All rays	261	1.64	0.1003	0.0174	33,040	0.1401	25,135	43,431	0.0132	26,558	0.1524	40,451	61,615
Mobula	210	1.61	0.0795	0.0134	25,534	0.1396	19,442	33,533	0.0123	24,788	0.2868	34,411	53,650
Rays no mob	51	1.77	0.3505	0.0039	7,506	0.3792	3,652	15,431					
Tuna	166	41.19	0.3858	0.2236	425,418	0.3840	205,061	882,570	0.1416	284,879	0.3294	187,505	573,561
Swordfish	233	1.11	0.0259	0.0104	19,756	0.1100	15,931	24,499	0.0140	28,174	0.1059	27,582	38,867
Small fish	144	22.11	0.4106	0.1321	251,426	0.4306	109,849	575,472					
Sunfish	342	1.11	0.0222	0.01493	30,097	0.3648	19,065	47,510	0.0136	31,131	0.0580	29,090	35,731

The parameters and results of the final detection functions and the final detection functions and q-q plots for all the species or groups of species of marine mammals are presented in the following Figures 10 to 18.



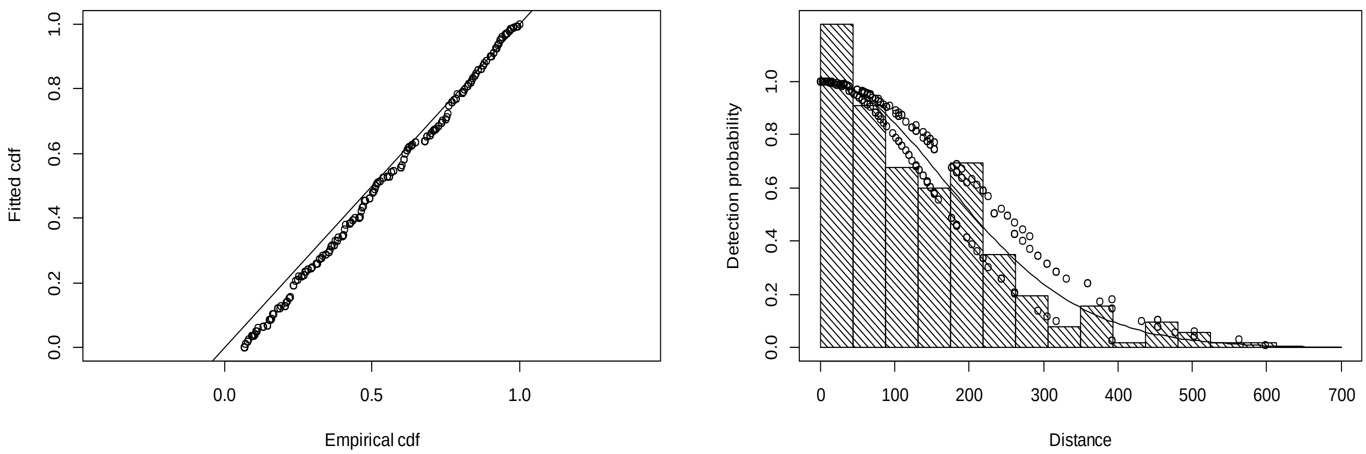
Q-q plot Detection function

Figure 10. Q-q plot and detection function for bottlenose dolphins. The detection function is scaled to 1.0 at zero perpendicular distance, and the histograms represent the frequency of the observed sightings at different perpendicular distances. Dots represent individual sightings and the effect of the covariates considered.



Q-q plot Detection function

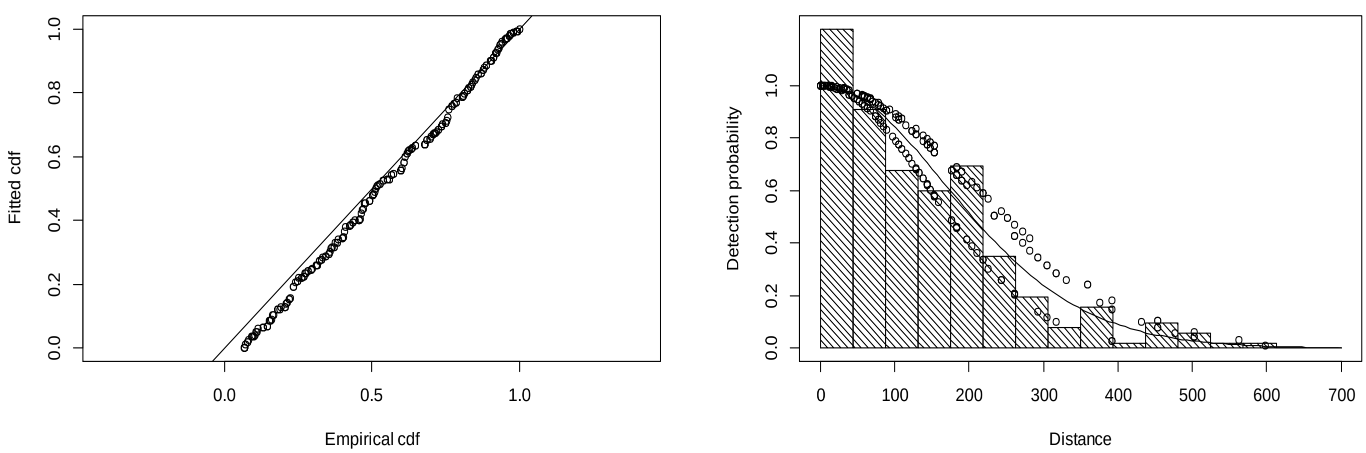
Figure 11. Q-q plot and detection function for Risso´s dolphins. The detection function is scaled to 1.0 at zero perpendicular distance, and the histograms represent the frequency of the observed sightings at different perpendicular distances. Dots represent individual sightings and the effect of the covariates considered.



Q-q plot

Detection function

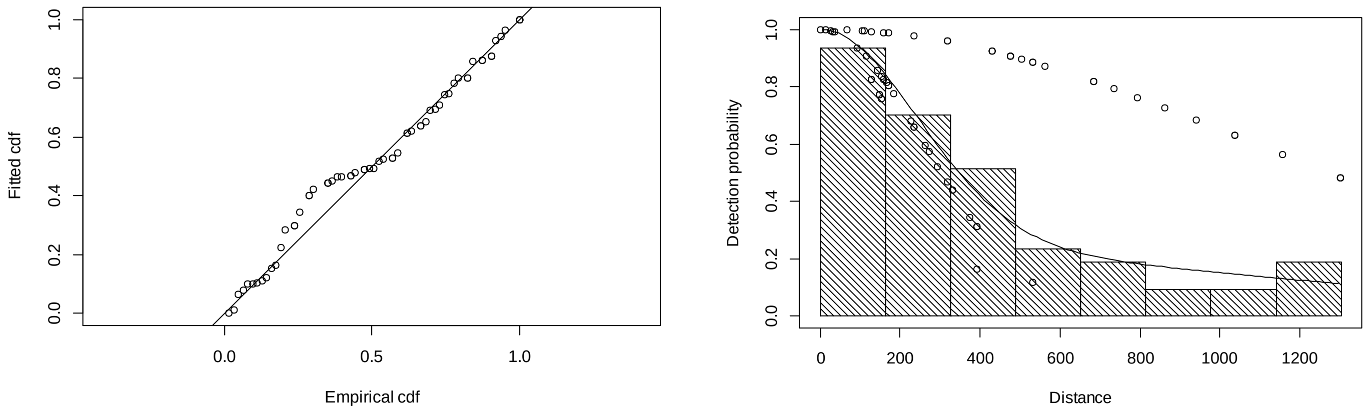
Figure 12. Q-q plot and detection function for striped dolphins. The detection function is scaled to 1.0 at zero perpendicular distance, and the histograms represent the frequency of the observed sightings at different perpendicular distances. Dots represent individual sightings and the effect of the covariates considered.



Q-q plot

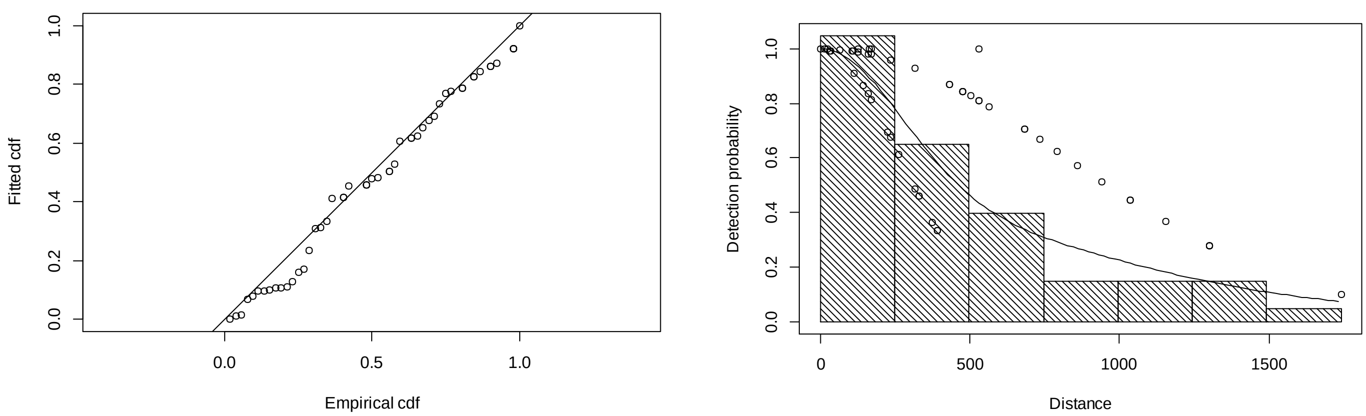
Detection function

Figure 13. Q-q plot and detection function for striped dolphins. The detection function is scaled to 1.0 at zero perpendicular distance, and the histograms represent the frequency of the observed sightings at different perpendicular distances. Dots represent individual sightings and the effect of the covariates considered.



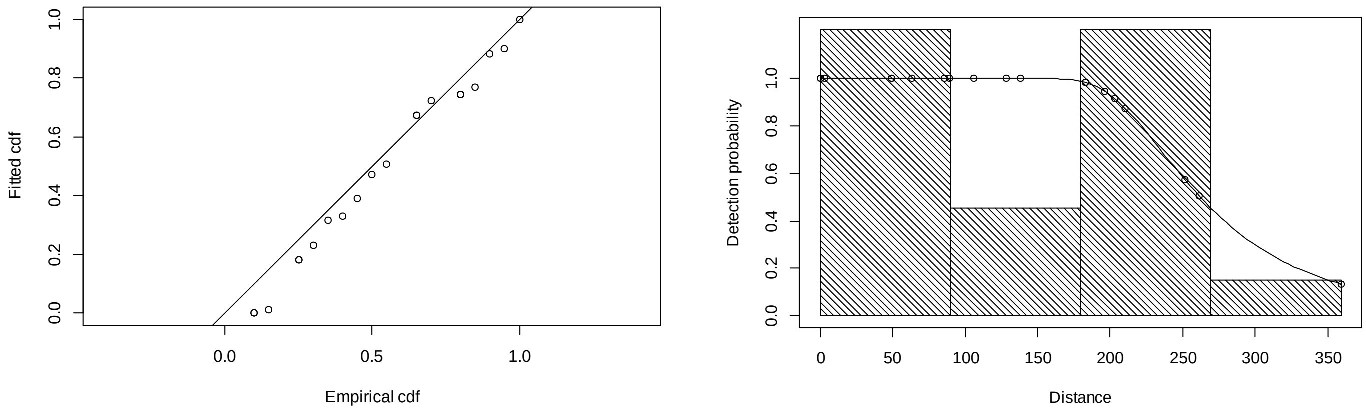
Q-q plot Detection function

Figure 14. Q-q plot and detection function for all whales (balaenopterids and sperm whales). The detection function is scaled to 1.0 at zero perpendicular distance, and the histograms represent the frequency of the observed sightings at different perpendicular distances. Dots represent individual sightings and the effect of the covariates considered.



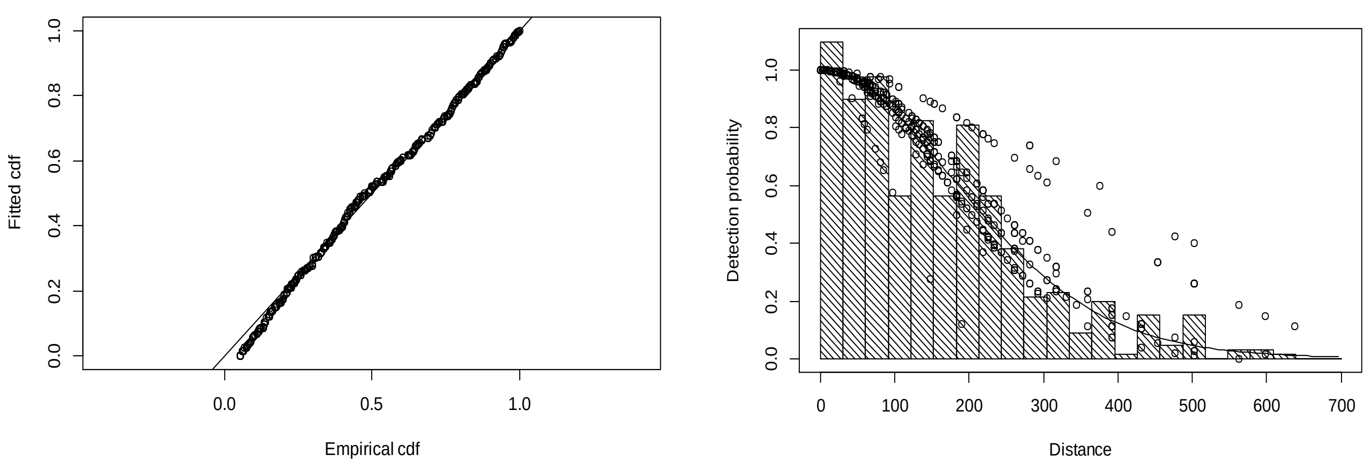
Q-q plot Detection function

Figure 15. Q-q plot and detection function for baleen whales (except minke whale). The detection function is scaled to 1.0 at zero perpendicular distance, and the histograms represent the frequency of the observed sightings at different perpendicular distances. Dots represent individual sightings and the effect of the covariates considered.



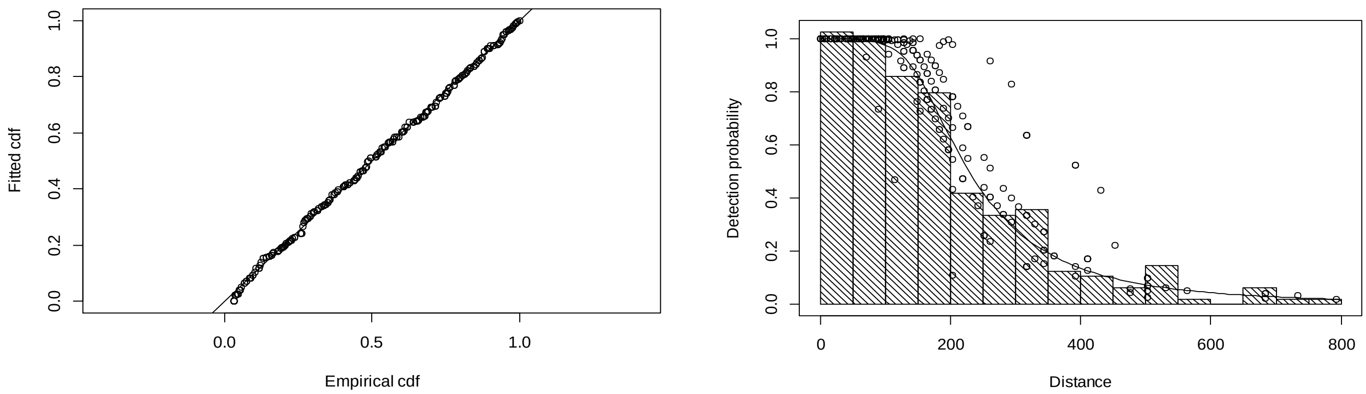
Q-q plot Detection function

Figure 16. Q-q plot and detection function for beaked whales. The detection function is scaled to 1.0 at zero perpendicular distance, and the histograms represent the frequency of the observed sightings at different perpendicular distances. Dots represent individual sightings and the effect of the covariates considered.



Q-q plot Detection function

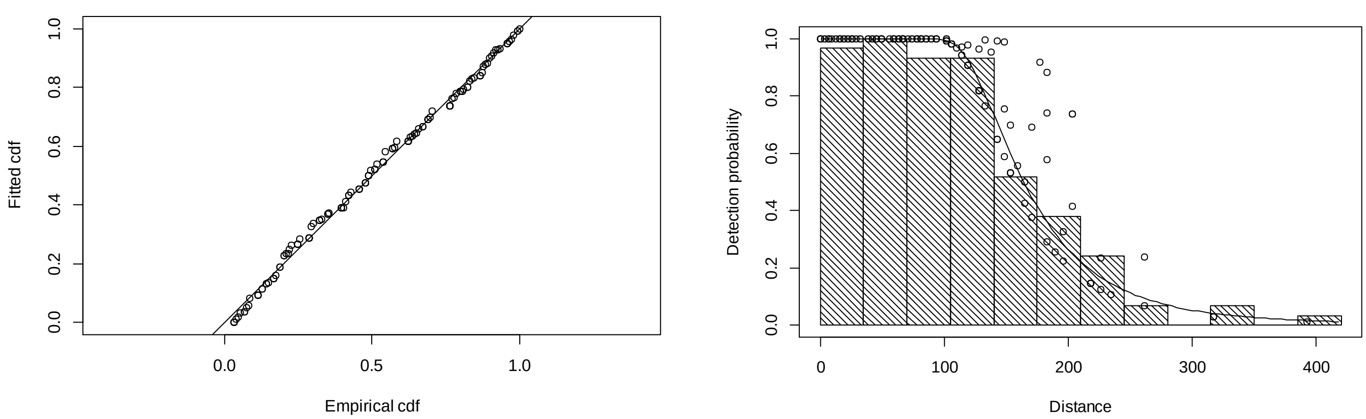
Figure 17. Q-q plot and detection function for small dolphins (common, striped and unidentified dolphins). The detection function is scaled to 1.0 at zero perpendicular distance, and the histograms represent the frequency of the observed sightings at different perpendicular distances. Dots represent individual sightings and the effect of the covariates considered.



Q-q plot Detection function

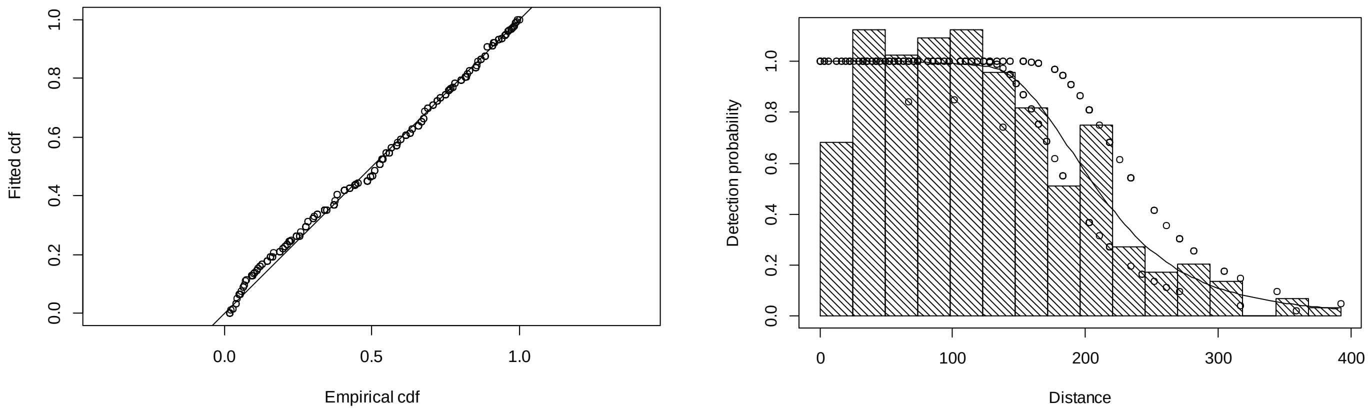
Figure 18. Q-q plot and detection function for large dolphins (bottlenose and Risso´s dolphins and long-finned pilot whales). The detection function is scaled to 1.0 at zero perpendicular distance, and the histograms represent the frequency of the observed sightings at different perpendicular distances. Dots represent individual sightings and the effect of the covariates considered.

Figures 19 to 22 show the final detection functions and q-q plots for all the groups of species of elasmobranchs and fish.



Q-q plot Detection function

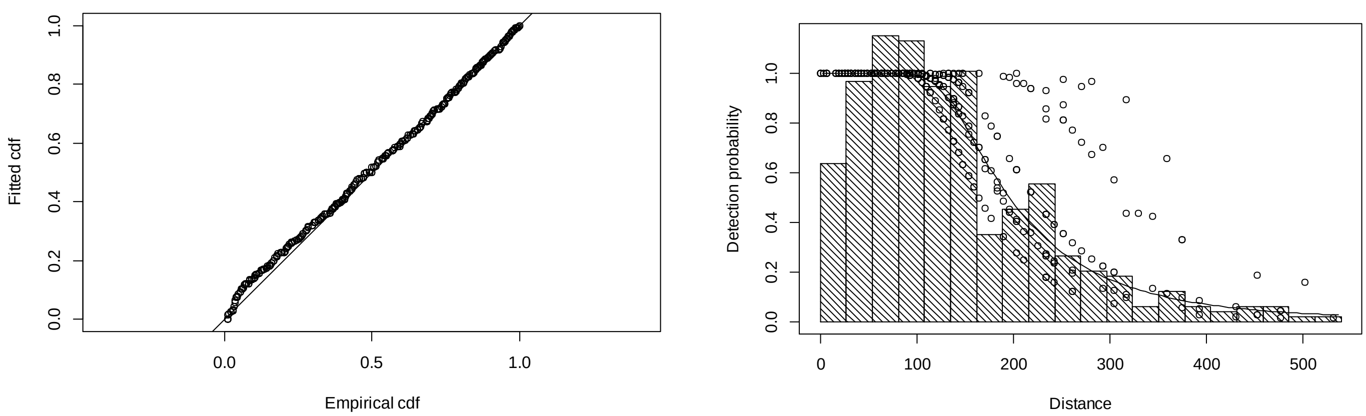
Figure 19. Q-q plot and detection function for sharks. The detection function is scaled to 1.0 at zero perpendicular distance, and the histograms represent the frequency of the observed sightings at different perpendicular distances. Dots represent individual sightings and the effect of the covariates considered.



Q-q plot

Detection function

Figure 20. Q-q plot and detection function for rays (including giant devil ray). The detection function is scaled to 1.0 at zero perpendicular distance, and the histograms represent the frequency of the observed sightings at different perpendicular distances. Dots represent individual sightings and the effect of the covariates considered.



Q-q plot

Detection function

Figure 21. Q-q plot and detection function for large fish (tuna and swordfish). The detection function is scaled to 1.0 at zero perpendicular distance, and the histograms represent the frequency of the observed sightings at different perpendicular distances. Dots represent individual sightings and the effect of the covariates considered.

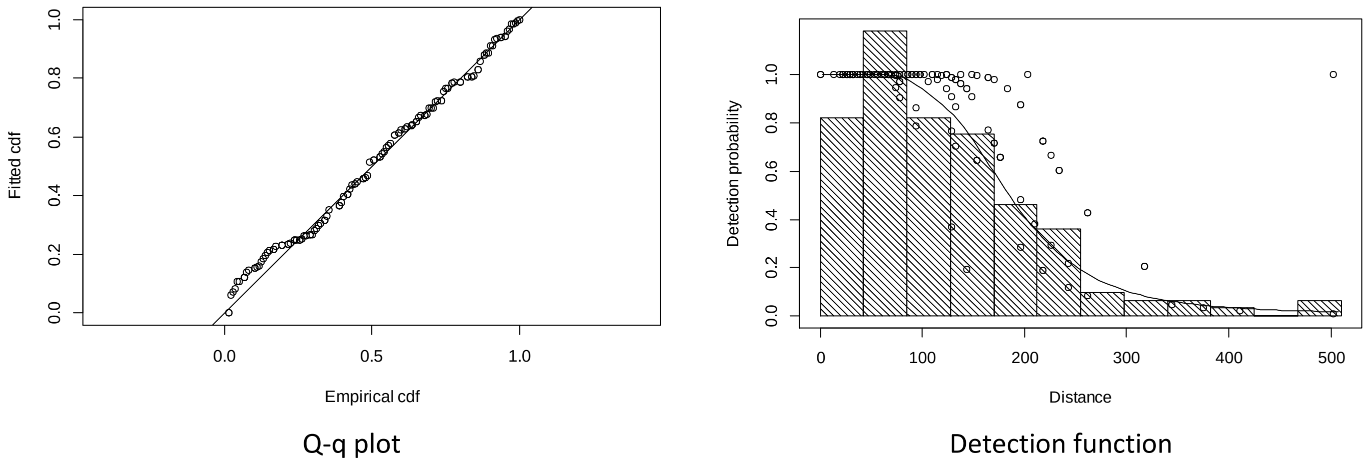


Figure 22. Q-q plot and detection function for small fish. The detection function is scaled to 1.0 at zero perpendicular distance, and the histograms represent the frequency of the observed sightings at different perpendicular distances. Dots represent individual sightings and the effect of the covariates considered.