

## CETACEAN CRITICAL HABITAT IDENTIFICATION PROCESS

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The Cetacean Critical Habitat (CCH) identification process was discussed during an expert's dedicated workshop, held in Cap d'Ail (France), on 10-11<sup>th</sup> March 2022.

Decisions and outputs of the workshop can be found in *MOP8/2022/Inf50\_Report of the Workshop on Cetacean Critical Habitats*.

### Aim

Cetacean Critical Habitat = maps of potential exposure level of cetacean's Habitat to the various anthropogenic pressures.

The CCH identification is a science-based process whose results will be displayed on a free accessible web-based GIS, NETCCOBAMS, and be useful for communication with stakeholders and decision makers at regional level, as an interface between science and policy.

Where the threat is known, the CCH will become the area where the focus should be put in order to seek for the relevant mitigation measures of, including place-based to sectorial-based and act.

It is complementary to national analysis and initiatives of any science, management and measures of conservation

### Limits

CCH = still an on-going process that has to be further enhanced by new results once they become available.

This process requires precise quantitative geographic data from different reliable sources, at the regional level, in order to combine data, and tailor them into the geographic outcome shape (simplified information) in order to highlight main areas where cetacean habitats and threats overlap.

CCH is not a Marine Protected Area.

## List of data providers used for CCH process

### Model of cetacean habitat:

- ACCOBAMS, ASI & CeNoBS
- Duke University Marine Geospatial Ecology Lab, Durham, North Carolina

### IMMA:

- IUCN Marine Mammal Protected Area Task Force

### Human activity data:

- SINAY
- Global Fishing Watch
- ACCOBAMS
- Halpern *et al.* 2008



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## 1 Introduction

According to the ACCOBAMS Conservation Plan (Annex 2 of the Agreement), Parties shall endeavor to establish and manage specially protected areas corresponding to the areas which serve as habitat of cetaceans. **The concept of Cetacean Critical Habitat logically includes a combination of cetacean occurrence and/or favorable habitat and actual and/or potential threats that may result in problems at the population level.** The ACCOBAMS Scientific Committee and Parties have already identified a number of important areas for cetaceans in the region in 2010 e.g., see the Annex to [Resolution 4.15](#), but those need urgently to be updated in the light of new available knowledge.

- **Definition**

**Cetacean Critical Habitat (CCH)** refers to those parts of a **cetacean’s range** that are **essential** for day-to-day well-being and survival, as well as for maintaining a healthy population growth rate” (Hoyt 2011).

- ✓ Areas used by cetaceans for feeding, breeding, calving, nursing and social behavior;
- ✓ Migration routes and corridors and related resting areas;
- ✓ Areas where there are seasonal concentrations of cetacean species;

It also incorporates the concept of actual human activities and/or potential threats at the (sub)population level, focusing on some of the most relevant “direct threats,” such as:

Human activity or PRESSURE	Threat
Large commercial vessels (cargo, ferries, tanker...)	Ship strike, continuous noise
Fisheries	Bycatch, depredation
Whale-watching	Disturbance, Harassment
Recreational vessels	Disturbance, Harassment
Oil & Gas activity, coastal building, etc.	“Hot-spots” of impulsive noise

The final aim is to identify, for each CCH, suitable management measures (place-based, sectoral based) for an effective conservation of cetacean species.

- **The CCH aims are:**

- ✓ Build a collaborative **science-based process with feedback validation**
- ✓ Build an **official communication tool** toward Parties and stakeholders, an **interface between science and policy**
- ✓ Build a **support** to help in identifying **where and what threaten cetaceans at regional level, a synoptic vision**
- ✓ To be used to **identify suitable management measures** (place-based, sectoral based) for an effective conservation of cetacean species
- ✓ **Launch at regional level, the implementation** of management and conservation measures, **complementary to any national initiatives**

- **What is a CCH?**

- ✓ An area showing at least the co-occurrence of species and pressures
- ✓ An area of general risk exposure (ref: ISO31000; Werner et al., 2016)
- ✓ With levels of confidence (based on expert’s knowledge about the threats and impacts in their areas)
- ✓ An area where management and measures of conservation should be implemented

- **The CCH Process and updates**

In order to define CCH, the aim was to build a clear and objective process using GIS tools and agreed rules, that are transparent and reproducible for the updates. It is not intended first to be a scientific study from raw data but a process using best existing results from the scientific community. The CCH process is an ongoing process that may be updated every 3 years, or before if a particular event happens.

- **Availability of the CCH outputs**

The different agreed layers used during the CCH process will be uploaded on the NETCCOBAMS platform GIS page, made visible and also available through a specific request form and with feedback/keep track on its use. The requests will be reviewed following the rules defined by the Scientific committee.

## 2 Geographic and temporal scales

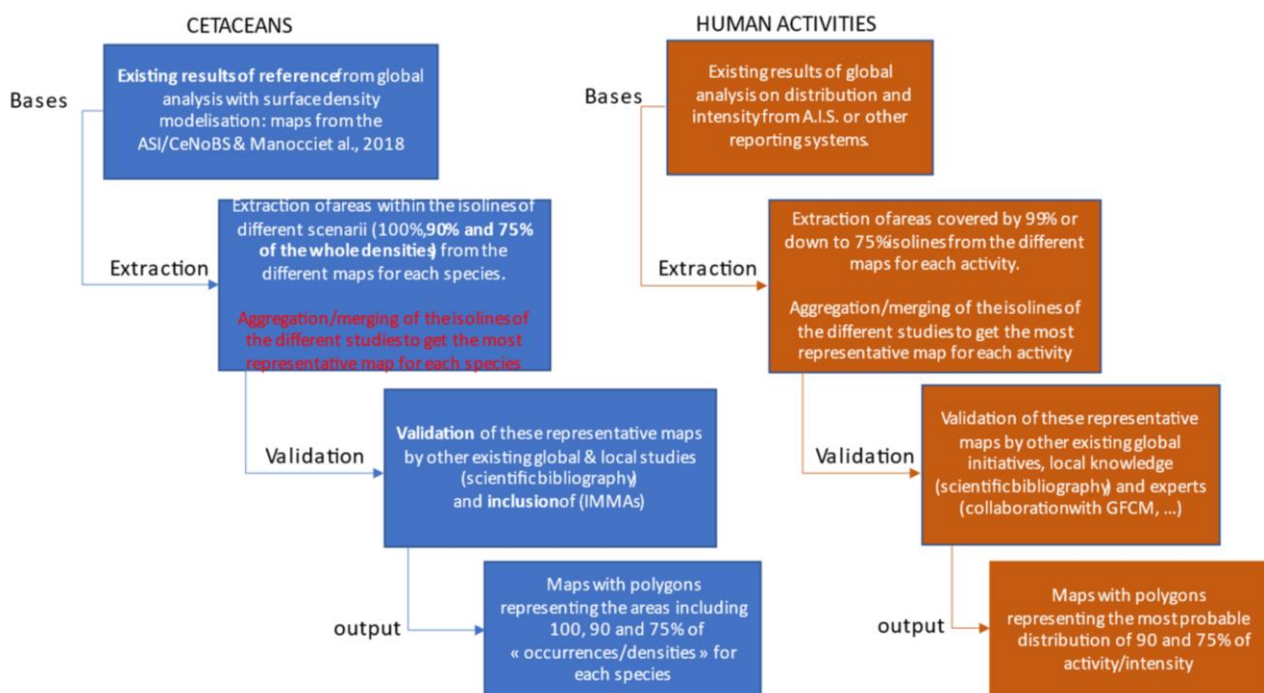
As the CCH is an ACCOBAMS initiative, the geographical scale is the entire Mediterranean Sea and the Black Sea. Both seas will probably be treated separately, but the process will be the same.

Considering temporality, the best period would be the season. This has to be tried when data are available at this scale. If not, then the year will be used.

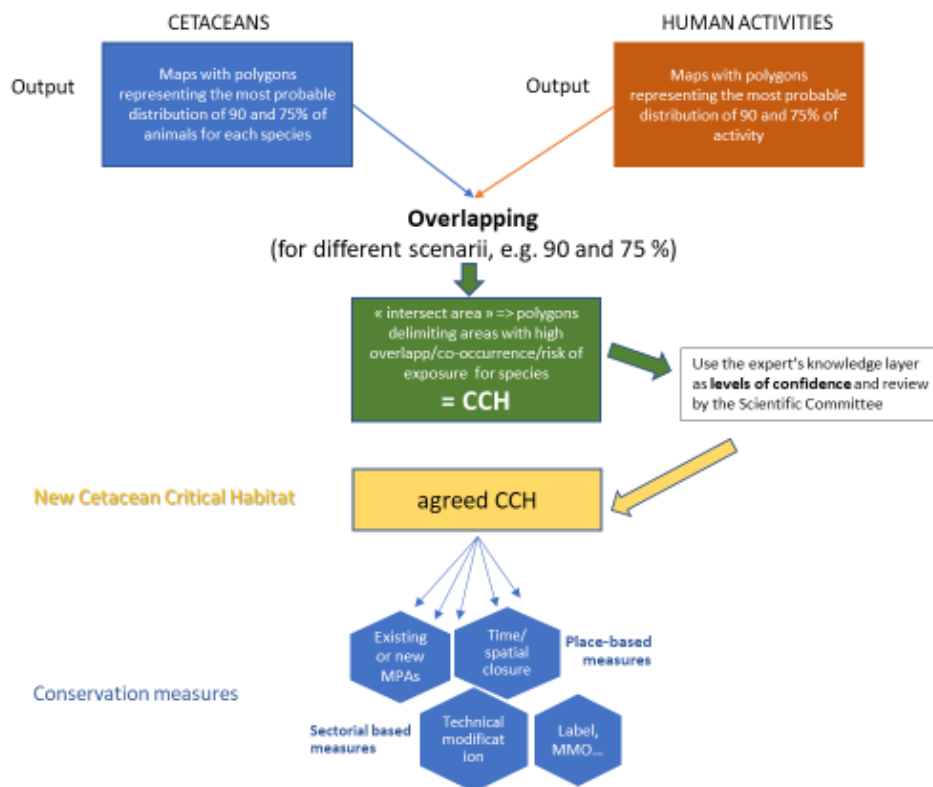
## 3 Summary of the global CCH process

Improvements in the Cetacean Critical Habitat process and method is described schematically in these figures and is explained in more details in this report.

### First step:



## Second step:



## 4 Cetacean data input and process

### 4.1 Cetacean input data

The bases are the existing “synthetic” studies/**analyses** that used a lot of existing data, for a large temporal and spatial coverage: the ACCOBAMS Survey Initiative or ASI and the Gap Analysis led by the Duke Marine Lab. in 2016-2018. The results of these studies were surface density modelling maps for species.

#### 4.1.1 ACCOBAMS Survey Initiative (ASI)

The results come from the ACCOBAMS Survey Initiative undertaken in the Mediterranean Sea (ACCOBAMS (a), 2021) and from the ASI/CENOBS/EMBLAS carried out in the Black Sea (ACCOBAMS (b), 2021). Target species are the fin whale, the striped dolphin, the Risso’s dolphin, the common dolphin, the bottlenose dolphin, and the harbor porpoise. There are no existing maps for the sperm whale, the long-finned pilot whale nor the Cuvier’s beaked whale.

Surface density modelling outputs were maps of densities expressed as the number of individuals per cell of 100 km<sup>2</sup>. Data have been collected during summer 2018 within the Mediterranean Sea and during summer 2019 for the Black Sea. Modelling has been realized only on data from aerial surveys.

#### 4.1.2 Gap Analysis and spatial models of marine species

A global Gap Analysis study was run by Mannocci and colleagues, based on gathered data, boat- or aerial based, from almost all teams working on cetaceans within the Mediterranean Sea from 1999 to 2016 (Mannocci *et al.*, 2018). Following this, the team developed marine species density models. Target species with enough data were the sperm

whale, the fin whale, the Cuvier’s beaked whale, the bottlenose dolphin, the striped dolphin, the long-finned pilot whale, the Risso’s dolphin and the common dolphin.

Surface density modelling outputs were maps of densities expressed as the annual mean of individuals per 25km<sup>2</sup>..

### 4.2 Creation of the “species” polygons of reference

When the information was available in files with format as .tiff or raster or .shp, they were included in the Geographic Information System or GIS (QGIS, version 3.16.6) project directly. For raster files, an extraction by contour has been realized, to get the delineated areas excluding the 10% very low values and the 25% lower values. So, a polygon including the cells with the 90% remaining values of densities, and another with 75%, have been extracted and used.

Figure 1 details the different steps under QGIS for the creation of the “species” polygons for the CCH process.

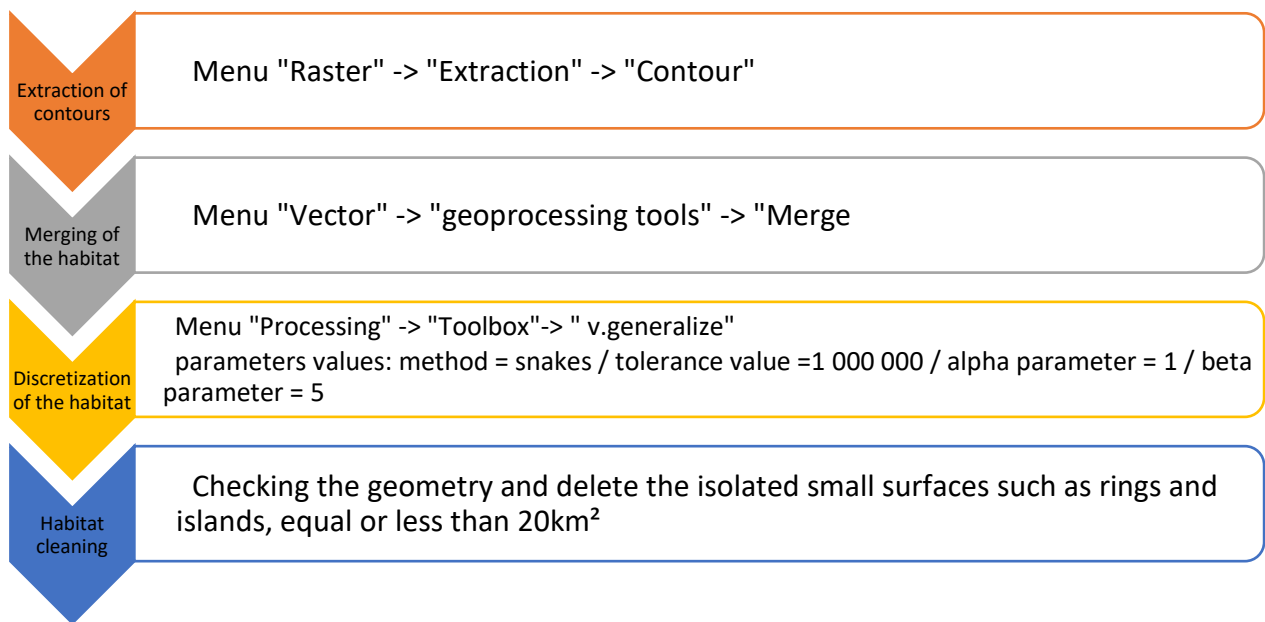


Figure 1: Procedure under QGIS

### 4.3 “Validation” process

As the data used by Mannocci and colleagues and data coming from the ASI&CeNoBS may have some temporal or spatial gaps, the polygons resulting from the CCH process explained before were then for each species compared to other maps resulting from other studies led at the sub-regional or regional scale. If maps were coherent, highlighting the same important areas for the species, then it “validates” the map of species for the following steps in the CCH process to be used. If it was not coherent in some areas (missing areas mainly), a more review process begins in order to know if the area has to be added or not, and if yes, then the results of the other study were used to fill the gap in the CCH species map. Scientific results as well as expert’s knowledge were considered for this step.

Table 1 shows the list of the main publications consulted for the different species.

Table 1: Main publications of reference used according to species

	Fin whale	Sperm whale	Bottlenose dolphin	Common dolphin	Striped dolphin	Risso's dolphin	Long-finned pilot whale	Cuvier's Beaked whale	Harbour porpoise
IMMAs	x	x	x	x	x	x	x	x	x
Arcangeli et al. 2019						x	x	x	

Bearzi et al. 2003			X		
Birkun et al. 2014		X	X		X
Cañadas et al. 2016				X	
Druon et al. 2012	X				
Lewis et al. 2018		X			
Notarbartolo di Sciara et al. 2016	X	X		X	X
Sánchez-Cabanes et al. 2017			X	X	X
Vella et al. 2021				X	

Examples of resulting maps from the CCH process, for the sperm whale (Figure 2), the fin whale (Figure 3), the bottlenose dolphin (Figure 4) are presented and are in accordance with those from the literature.

However, for the common dolphin and the harbour porpoise, the obtained results do not reflect all the known suitable habitats. To overcome this lack, it was chosen to add the IMMAs regarding each species. Indeed, the IMMAs represent important areas for cetaceans and have been validated according to specific criteria based on scientific results (IUCN MMPATF, 2016).

Example of draft maps that can be obtained for species (Figure 2, Figure 3, Figure 4) three species (validation process is still ongoing).

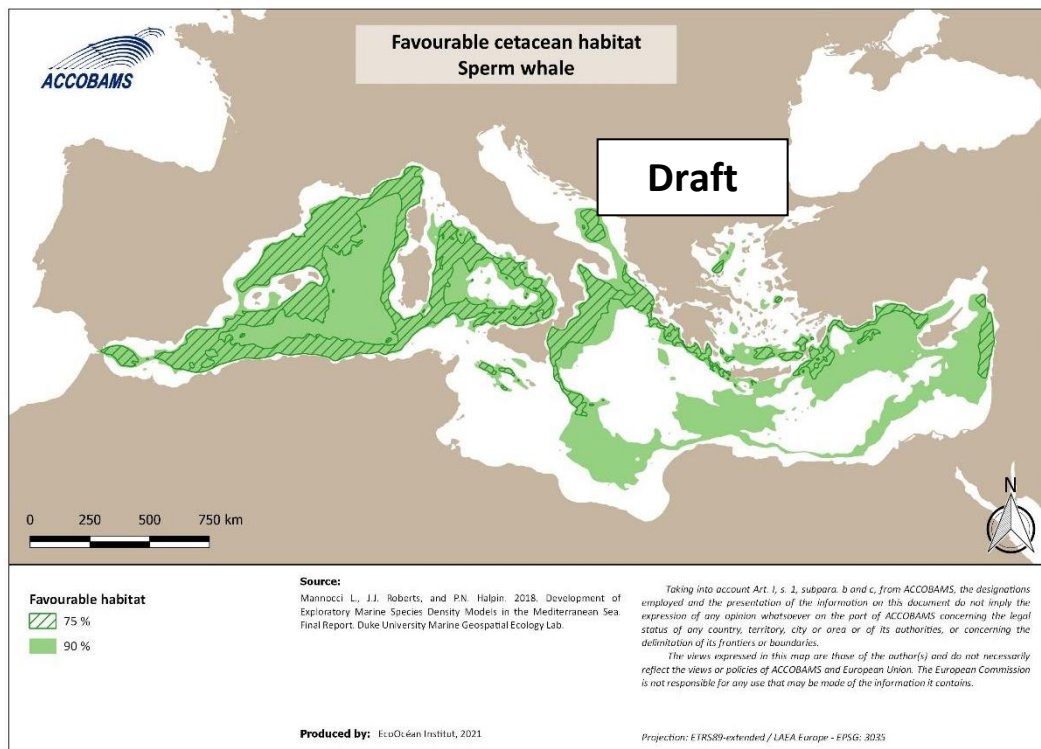


Figure 2: Favourable habitat for the sperm whale (draft)



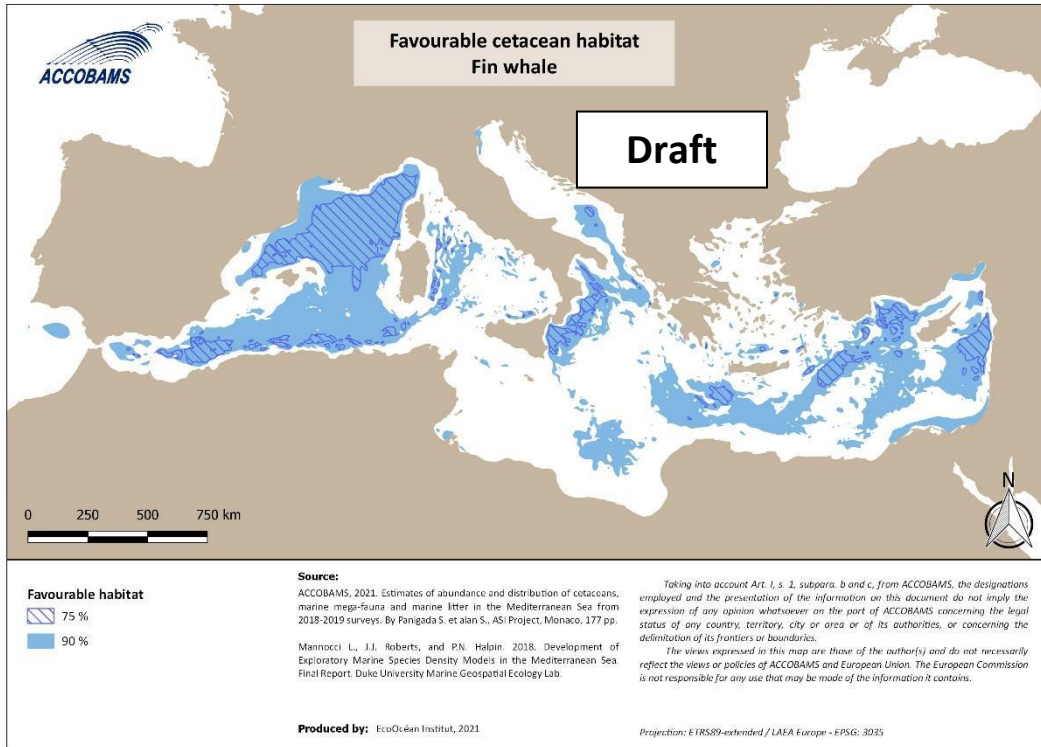


Figure 3: Favourable habitat for the fin whale (draft)

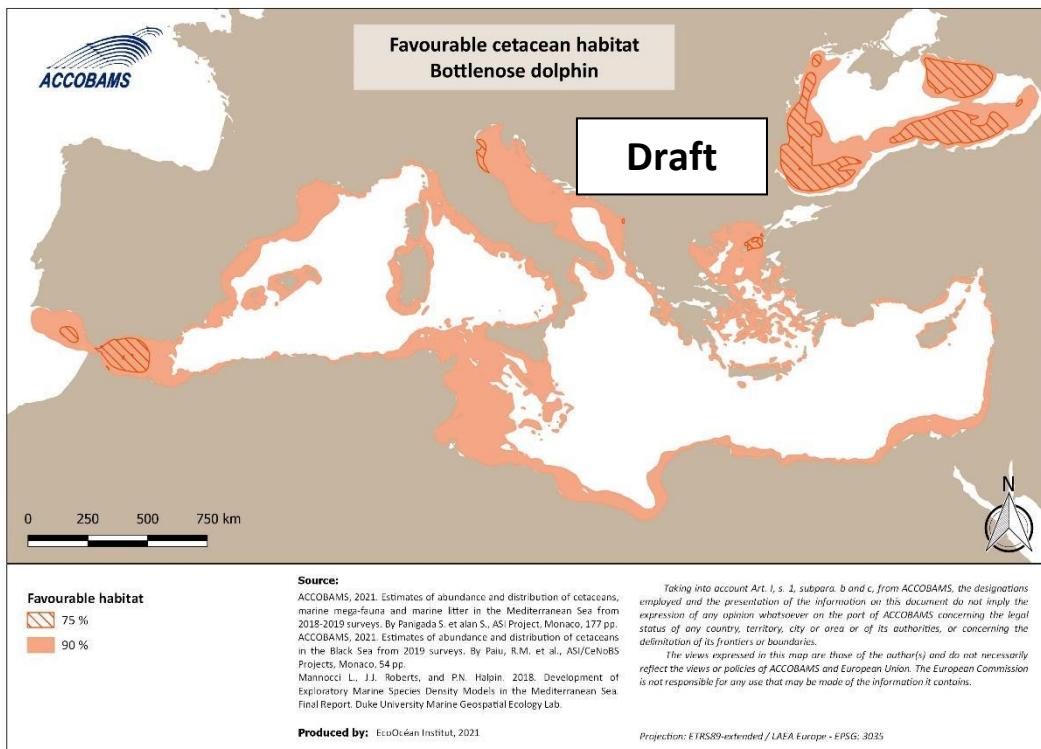
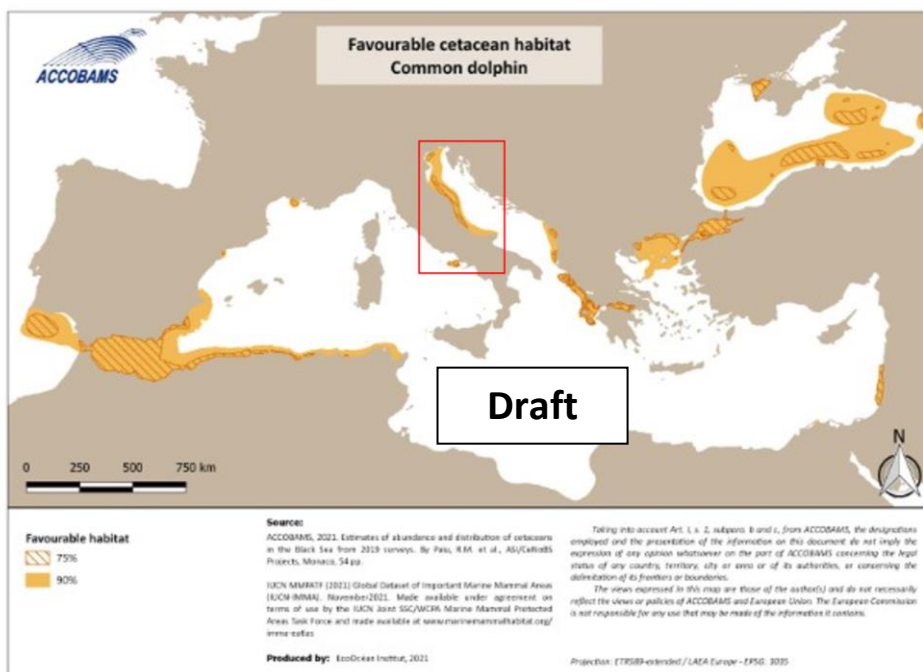


Figure 4: Favourable habitat for the bottlenose dolphin (draft)



What about a favourable habitat with no sightings ?

Figure 5: Favourable habitat for the common dolphin

The aggregation and merging of different types of maps, even if the metrics are the same (densities) and the analysis too (surface density modelling), could pose some questions. Also, there is some consideration that some areas were not covered with line transects or only recently. Knowing that the Duke Marine Lab is launching a new wide analysis of surface density modelisation for the Mediterranean Sea and also the Black sea right now, that the outputs will be available early 2024, and that they intend to gather as many existing datasets as possible enlarging the type considered (small boat, ferries, aerial) and the method (distance sampling, in effort, line transect...), it seems obvious to wait until their outputs come. The task manager and Steering Committee of the CCH process will be in touch with the Duke Marine Lab in order to get all the information necessary: uncertainties, effort coverage for the spatial confidence, modelisation with average and lower and upper boundaries as scenarios to consider, seasonal maps, when possible, etc. In the meantime, participation by all providers of data to the Duke Marine Lab. initiative is strongly recommended.

In the future, all maps will include the information regarding the level of confidence for the species, mainly based on the existing effort coverage in the area, as: High confidence / Medium confidence / Low confidence / Unknown. This effort coverage will be provided by the Duke Marine Lab. upcoming work and also based on existing literature.

If an area is highlighted by the mapping exercise, and if there is a high level of effort coverage but no sightings of the species, then the area will be deleted for the species (ex: common dolphin in the Adriatic Sea).

Moreover, if an area known as feeding ground for a species but not highlighted by the surface density modelling analysis, as the known seasonal feeding ground of fin whale around Lampedusa Island or in the canyons of the Gulf of Lion and offshore Barcelona coasts in spring, they will be added to the map.

## 5 Data on human activities and process

### 5.1 Marine Traffic (large commercial vessel)

#### 5.1.1 Marine traffic input data

The marine traffic of large commercial vessels is monitored at sea with a mandatory tool, the Automatic Information System (AIS) and each vessel over a specific tonnage around the world is equipped with AIS. Maps were built based on AIS data from the whole 2018 year.

The grid resolution is 0.1x0.1; and the unit corresponds to the number of AIS messages emitted over the grid surface during the study period. Analysis and compilation of AIS data have been realized by SINAY. The category of large commercial vessels includes cargos, tankers, container ships, ferries, cruise vessels...

A first improvement could be to exclude the A.I.S points of vessels at anchor. A second one could be to use a different metric, as hours/gris cells or even use an analysis that reconstructs the trajectories of each vessel from its emitted points, in order to fill the gap in areas where low transmission could have a bias for the mapping exercise.

A working group will be created in order to fix the best metrics to use, the analysis to lead and also the sources of data to consider (cost, availability, reliability, update frequency...ex: EmodNet), in collaboration with experts on maritime traffic data.

#### 5.1.2 Marine traffic polygons

The same method as for the cetacean polygon process has been applied: contour extraction / discretization / cleaning. At the end, isopleth 75% and isopleth 90 % of the annual traffic in the Mediterranean Sea are displayed respectively on Figure 6 and Figure 7. This exercise can also be done per speed categories, per type of vessel if needed.

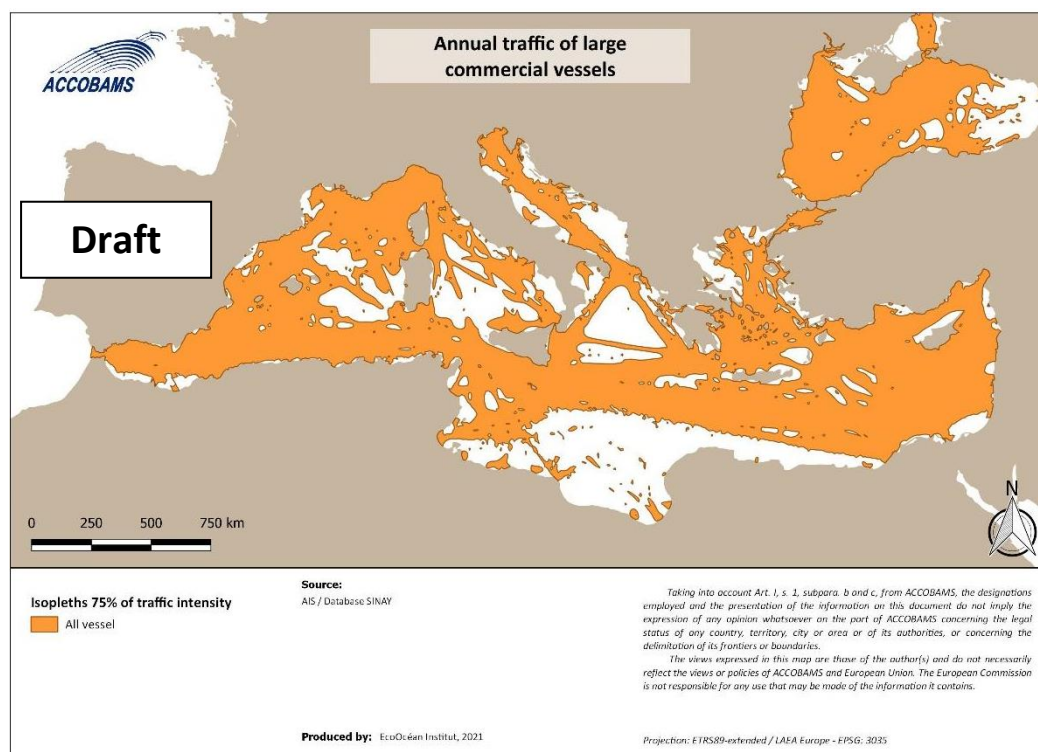


Figure 6: example of marine traffic polygon (Isopleth 75%)

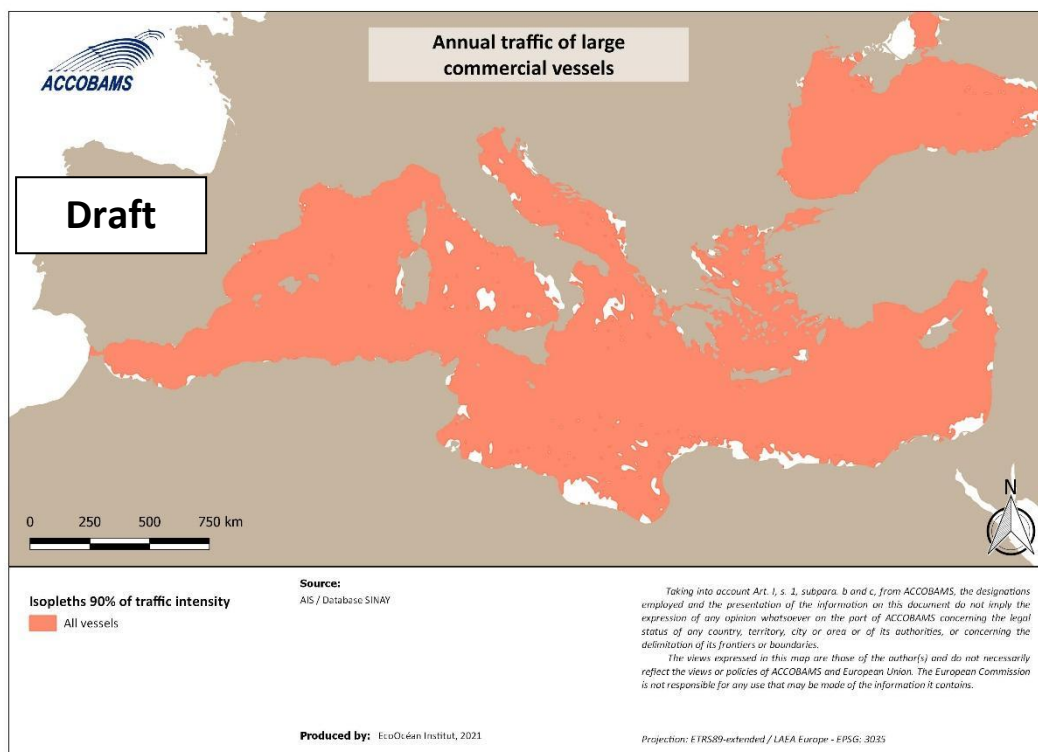


Figure 7: example of marine traffic polygon (Isopleth 90%)

### 5.1.3 “Validation”

The annual density map of marine traffic displayed on the web site <https://www.marinetraffic.com/> has been used to validate or complete the information regarding the maritime traffic, as well as the Medtrends work (Piante and Ody, 2015).

## 5.2 Fishery

The fishery activity at sea is not easy to map. Indeed, some tools to follow each vessel at sea exist, such as the AIS, but this tool is mandatory for European vessels only, and for vessels larger than 12 m only. Therefore, as the fishery fleet in the Mediterranean Sea consists of 83% of small-scale vessels (Figure 8, FAO, 2020), without AIS, those ones are not monitored at sea. Large vessels from non-European countries are not traceable at sea either. Another way to manage fishery vessels at sea mostly in European countries is the VMS tool. But those data are not easily available for most of the countries and where AIS exists, it does not bring much more than the easily accessible AIS.

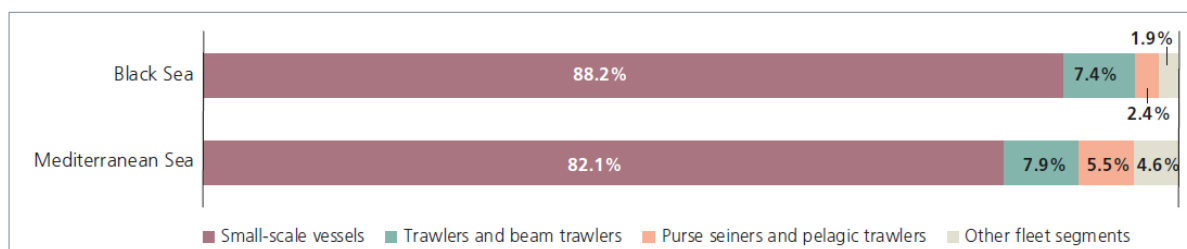


Figure 8 : Fleet segment composition in the Mediterranean and Black Sea, FAO 2020

### 5.2.1 Fishery input data

Data on fishery activities come from the AIS results from the Global Fishing Watch website<sup>1</sup>, free of access, and consists of a compilation of daily hours of fishing during the year 2018 in a grid of 0.1x0.1° cells.

Global Fishing Watch analyzes AIS data collected from vessels identified as known or possible commercial fishing vessels and applies a fishing detection algorithm to determine “apparent fishing activity” based on changes in vessel speed and direction. The algorithm classifies each AIS broadcast data point for these vessels as either apparently fishing or not fishing and shows the former on the Global Fishing Watch fishing activity heat map.

Vessels are divided into 5 categories:

- drifting longlines
- seiners: vessels using seine nets, including potential purse seine vessels, targeting tuna and other species, as well as danish and other seines
- trawlers: all types
- fixed gear: a category that includes potential set longlines, set gillnets, and pots and traps
- all fishing

### 5.2.2 Fishery Polygons

The same method as for the cetacean data process has been applied to obtain the polygon of this activity: contour extraction / discretization / cleaning. However, because the activity exploits the sea in a dynamic way, not going each time exactly in the same place, it appears that the intensity expressed in those small cells seemed not the best parameter to represent this activity spatially. Indeed, the 75% of effort highlighted really very small areas, and mapping outcomes appear really not representative of this activity at sea. . So, it was decided to keep almost the 99% effort.

### 5.2.3 Validation

Several works about spatialization of fishery activities exist based on AIS e.g.:

- Piante & Ody, 2015.
- Vespe et al., 2016

Their comparison shows that the maps obtained are all almost the same.

Nevertheless, in order to take into account also the artisanal fleet, the layer produced through modelisation by Halpern et al. (2008) of this activity in the Mediterranean Sea and Black Sea, was downloaded and added to the map of this pressure. And considering the data collected during the ACCOBAMS Survey Initiative on fishery vessels and the results obtained from those data by David & Roul (2021), it appears important to think about using those results (kernel analysis) to fill some gaps in the pressure map too. Then, the final map could merge the polygons of the three sources as shown in Figure 9.

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<sup>1</sup> <https://globalfishingwatch.org/map/>

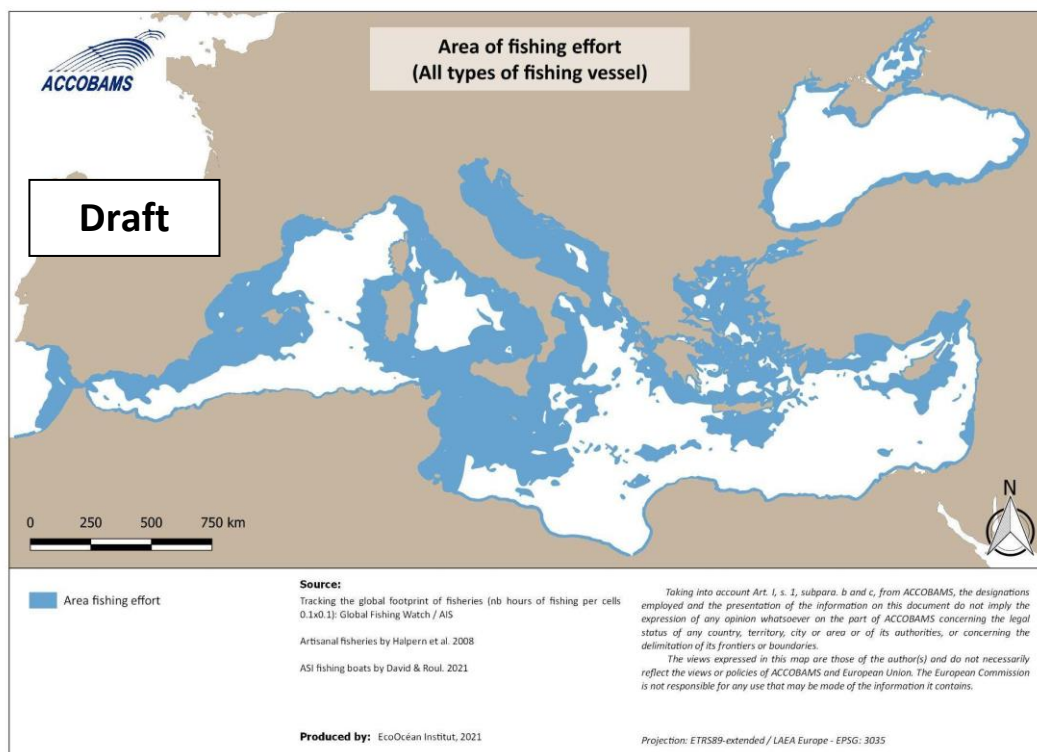


Figure 9: Area of annual fishing effort in the Mediterranean Sea and the Black Sea (draft)

A working group will be created in order to determine which metrics, analysis and sources of data to consider (cost, availability, reliability, update frequency...), in collaboration with fishery experts (GFCM experts, IWC). It may be common with the WG on AIS for maritime traffic.

Another interesting way of mapping or “validating” areas, would be to use data collected at sea from different sources. Several ACCOBAMS partners or global initiatives (ASI, SAMM, FLT) collect data on human activities and those could be used.

### 5.3 Whale watching

Existing maps of the whale-watching pressure at sea exist, but locally in France (Mayol *et al.*, 2012) or in Italy (Sicomar project). The project of mapping this activity at the ACCOBAMS scale is ongoing, in link with the ACCOBAMS working group on Whale-watching.

#### 5.3.1 Whale watching input data

The ideal is to use data recorded directly from observers onboard or owners of the Whale-watching vessels during their trips. As this does not exist at the regional scale, it is planned to model simply the answers coming from the questionnaire sent by the ACCOBAMS working group on whale-watching (WWWG) and the consultant on that topic to all focal points and experts. The questionnaire requests information on the frequency of trips and the areas usually covered.

### 5.4 Recreational vessel

No precise map of this activity exists within the ACCOBAMS area.

What is planned is to use or redo the modelling exercise available in Piante & Ody (2015) or Halpern *et al.* (2008).

For the validation process, the data on human activity from direct observation at sea, like the one collected by the Medtrix aerial surveys along the French Mediterranean coasts (<https://medtrix.fr/>), will be used.

## 5.5 Fix and punctual activities: fish farms, oil & gas platforms and seismic exploration

Maps of some fixed activities, such as fish farms and oil & gas platforms may be drawn, based on existing knowledge and official listing and charts as future steps.

Considering more punctual activities, such as seismic exploration or coastal building, it is difficult to map those in the CCH process as they are not permanent. The base of these activities will be taken from Maglio et al., 2016 when it will be updated.

## 6 Overlap of species and human activities maps, creation of new CCH polygons

### 6.1 Overlap and intersect

The “species” polygons will be overlapped with the “human activity” polygon through GIS. The resulting overlapping part will define the potential “interaction” areas. Within those interactions are the threats to the species. As first examples, the CCH exercise has been run on known threats as:

- Marine traffic and large species of cetaceans (fin whale and sperm whale) for ship strike and continuous noise
- Fishery and delphinids (bottlenose dolphin, common dolphin, striped dolphin and harbour porpoise) for depredation and bycatch

But any overlap can be realized, as sperm whale and Risso’s dolphin versus fishery, all species versus recreational vessels and whale-watching, and coastal species versus coastal building. Globally the exercise should be done at least at the two levels of 90% (conservational approach) and 75%, and at other levels if needed.

*Qgis procedure: use the species layer (favorable cetacean habitat) as the first layer, then the pressure layer (human activity) as the overlay layer through the tool “Vector” -> “Geoprocessing Tools” -> “Intersect”.*

**The intersecting part of this overlap constitutes the CCH polygon.**

The final maps of example of the CCH are presented below and represent the areas of co-occurrence of species and pressures and even the areas with risk of exposure for the species from a specific human activity (Figure 10, Figure 11).

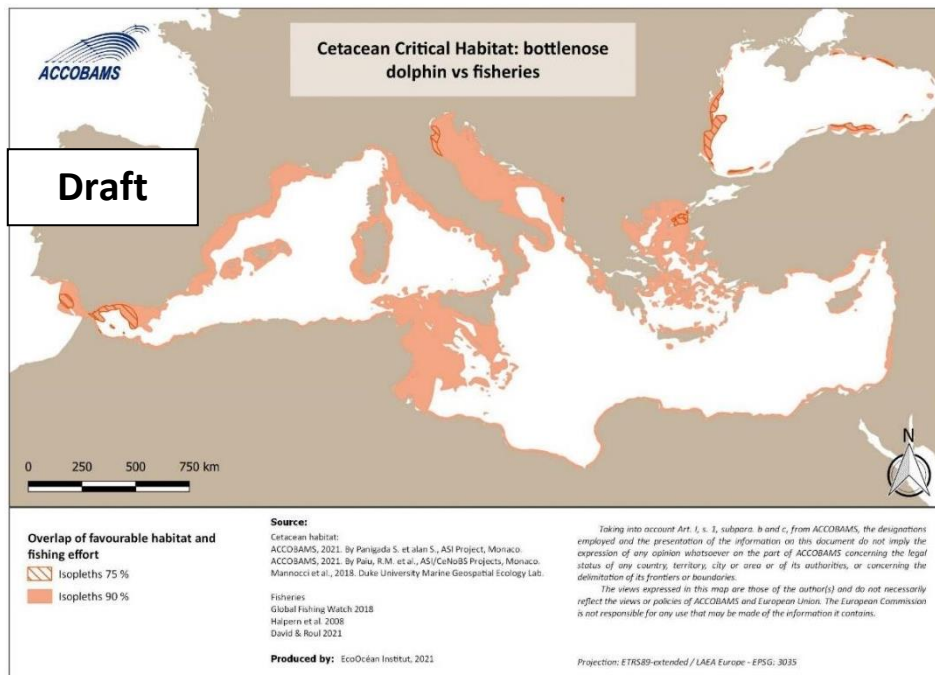


Figure 10: Example of Cetacean Critical Habitat of the bottlenose dolphin versus fishery activities in the Mediterranean and the Black Seas (draft)

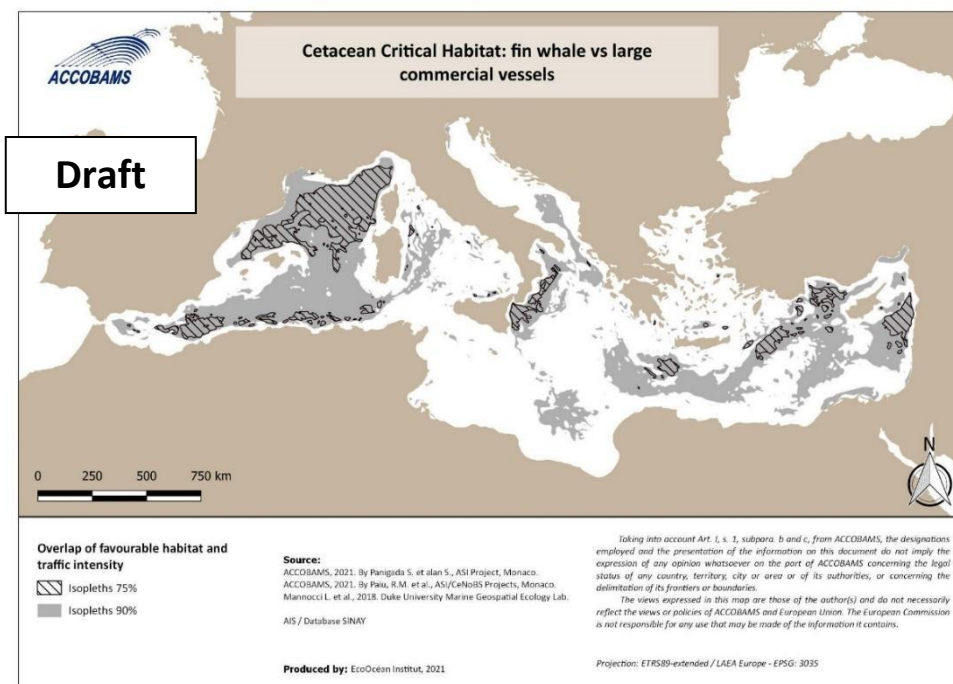


Figure 11: Example of Cetacean Critical Habitat of the fin whale versus marine traffic in the Med. Sea (draft)



## 6.2 Use of the level of confidence brought by “expert’s knowledge” to agree for the proposed new CCH

The expert’s knowledge is provided through a questionnaire they fill and associated polygons they send to ACCOBAMS. The questionnaire, guiding document and polygon’s rules have been improved from those used for the 2017 workshop (ACCOBAMS, 2017). A global review process of those inputs will be led by the Scientific Committee.

Those inputs are considered as knowledge on threats and moreover also on impacts, happening in the different areas within the ACCOBAMS area. They will be used to define the level of confidence in the CCH highlighted by the mapping exercise of the CCH process. The CCH will then be classified following the categories: confident / Potential / Unknown

An example of this mapping comparison between CCH and expert’s knowledge layer regarding the human threats is show in Figure 12 and Figure 13.

### Comparison between the CCH of fin whale versus marine traffic and the expert’s knowledge

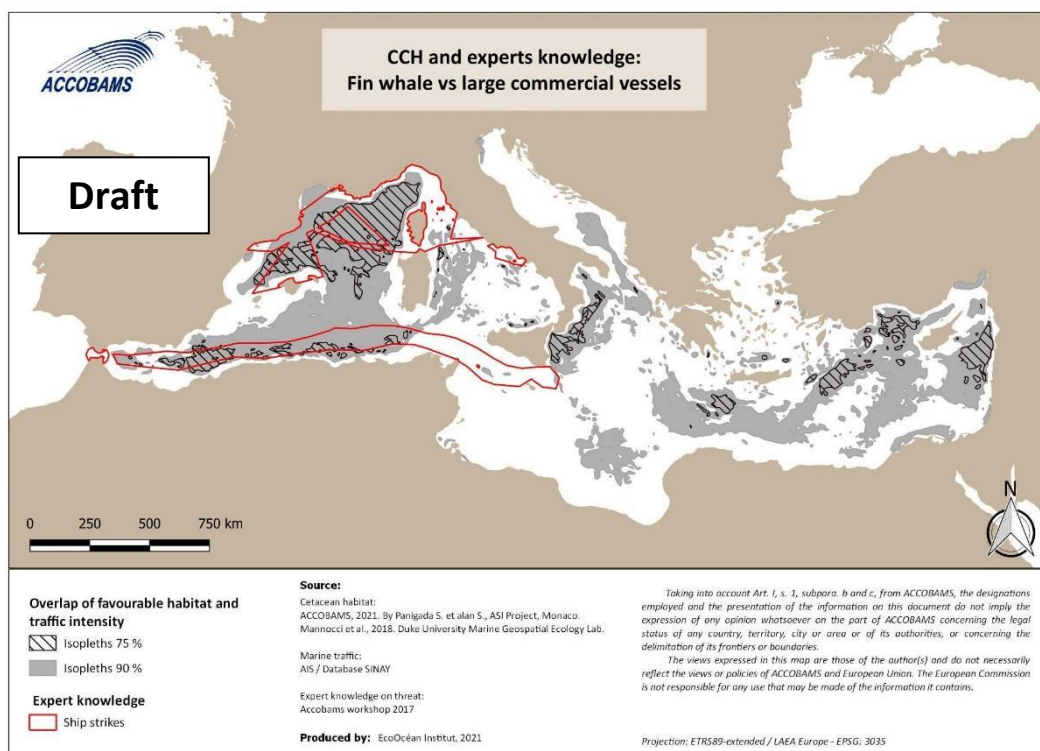


Figure 12: Example of map of comparison between the Cetacean Critical Habitat of the fin whale vs marine traffic and the expert’s knowledge in the Mediterranean Sea (draft)

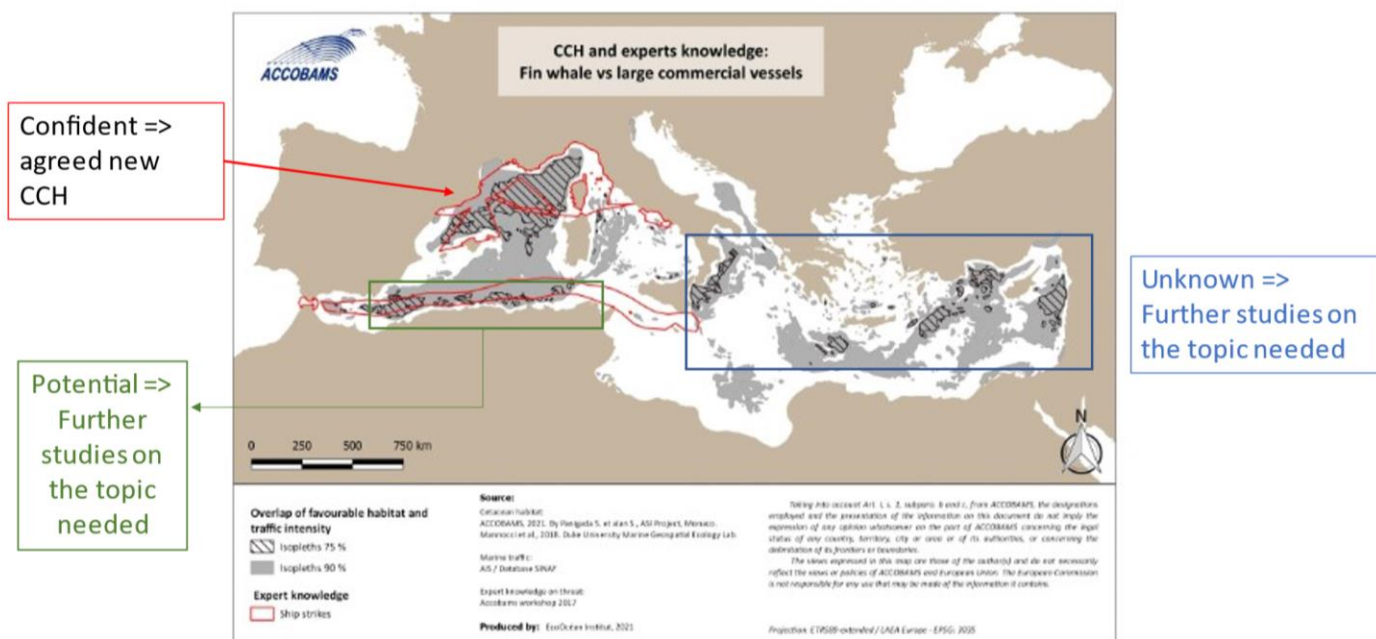


Figure 13: Example of map of comparison between the Cetacean Critical Habitat of the fin whale vs marine traffic and the expert's knowledge in the Mediterranean Sea with level of confidence induced

### 6.3 Identification of the type of interaction and/or threat within the CCH

CCHs have been built with human activities maps and species maps. But one pressure may impact in different ways the same species, as for example, marine traffic may impact fin whales through ship strike and also through continuous low frequency noise. So, the CCH “marine traffic” for fin whales will/may represent both those threats. If potential of ship strikes and potential impact of continuous noise have been analyzed and mapped separately, then within the CCH “marine traffic and fin whale” it will be possible to find the different threats maps.

For fishery, at this stage, only a global CCH of potential interactions can be drawn. Those interactions can be, at a further step, defined per gear or métier. Such a layer per gear can be done as some data exist per gear, but not sure if data exists or are available to spatialize at the Mediterranean level or ACCOBAMS level the different types of fishing or métier.

## 7 Perspectives for management and/or conservation measures

As a first next step, the obtained CCH should be discussed among the Scientific Committee and relevant experts with updated knowledge.

Then the process to simplify the limits of the polygons defining areas easier to be managed will arise. The rule for smoothing the CCH shapes, will be the following:

- Smoothing automatically through GIS tools
- Include buffer area
- Review and improvement in a case-by-case basis from experts

Then, identification of relevant measures for adequate management in each CCH will have to be discussed, in collaboration with all stakeholders including other Organizations, such as UNEP-MAP/RAC-SPA, BSC, IMO, IWC, and GFCM, in particular through the Strategic Alliance.

For management purposes there will probably appear the need to lead furthermore in-deep analysis, either on a case-by-case CCH basis, or for some, at the regional scale. For example, for marine traffic and ship strikes, as lethality rises with speed of the vessels, it may be useful to define the parts of the CCH which include the paths of the vessels with the highest speed. In the example below, vessels were split into 3 categories, with threshold coming from a review of the literature on ship strike for cetaceans:

- ships with speeds  $\leq 14$  knots
- ships with speed ranging between 14 and 30 knots
- ships with speed  $> 30$  knots

### Example of marine traffic in the northwestern Mediterranean Sea (NWMS)

Figure 14 and Figure 15 show examples of the overlap of respectively 75% and 90% of the favorable habitat of large cetaceans and the annual marine traffic of large commercial vessels split by categories of speed, focused on the NWMS.

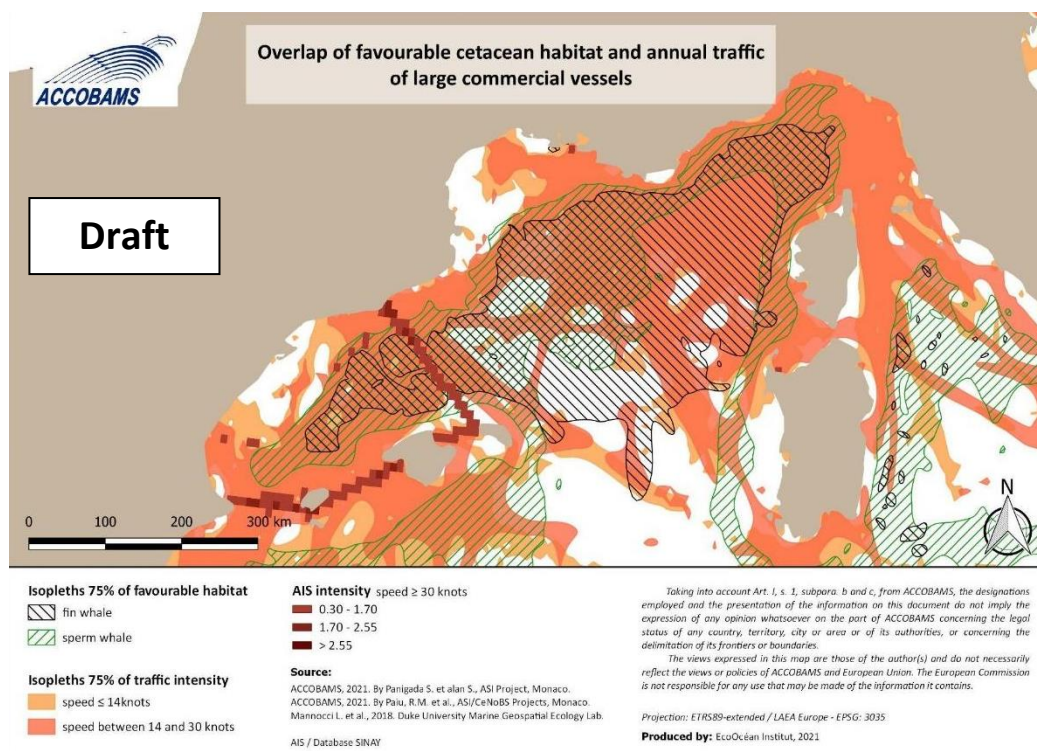


Figure 14: Overlap of 75% of the favorable habitat of large cetaceans and 75% of the annual marine traffic with vessel speeds  $\leq 14$  knots, between 14 and 30 knots and  $> 30$  knots, in the NWMS

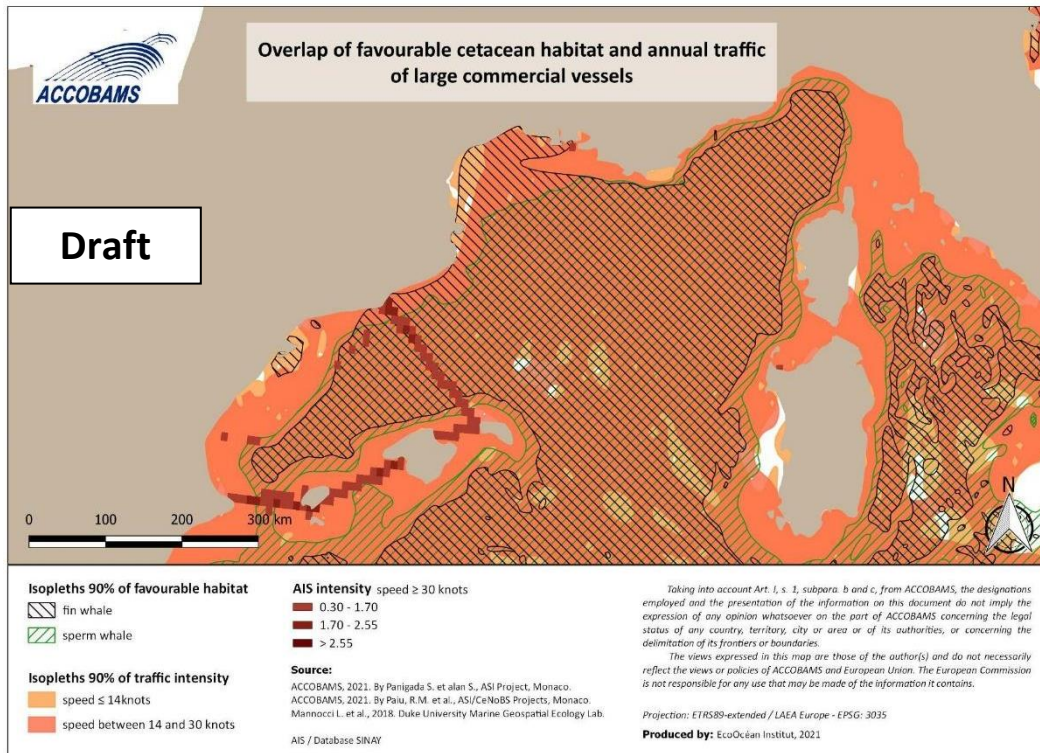


Figure 15: Overlap of 75% of the favorable habitat of large cetaceans and 75% of the annual marine traffic with vessel speeds ≤ 14 knots, between 14 and 30 knots and > 30 knots, in the NWMS

Another example is the need to go further in precision as for the fishery activities that need to be mapped by gear or job, at the ACCOBAMS scale or at some CCH scale.

Globally, it seems that the exercise is a useful tool and there is a need to pursue the exercise with all types of pressures and species. It highlights areas where cetaceans may be at risk, and where this is already known and the work toward identifying the adequate management measures should begin. But it also shows where a cetacean may be at risk in areas unknown or less known yet by the scientific community, needing research to confirm their status of CCH. The example in Figure 16 shows how CCH maps can be used.

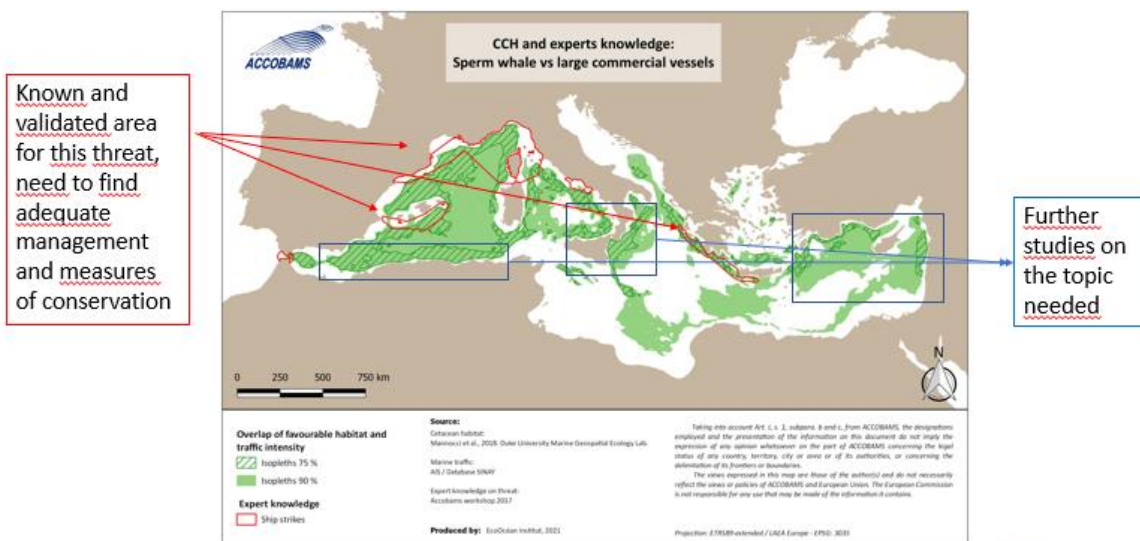


Figure 16: Perspectives of work from CCH maps

Moreover, for punctual/temporal human activities generating impulsive noise, such as oil & gas prospecting, naval exercises, explosion, coastal building, etc., it is not possible to define CCH related to them due to their punctual occurrence. Nevertheless, those activities are impacting cetaceans and should therefore be considered within the process. Therefore, a simple rule can be agreed on: none of those activities should occur within the IMMA or within the cetacean's species reference maps or within an existing Marine Protected Area (<https://mapamed.org/>). If it may occur, each time a human activity generating impulsive noise is located within an IMMA or within the cetacean's species reference maps or within a MPA, it should be considered as a punctual/temporal CCH and mitigation measures (impact assessment study, sectoral measures, operational measures...) should automatically be requested.

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