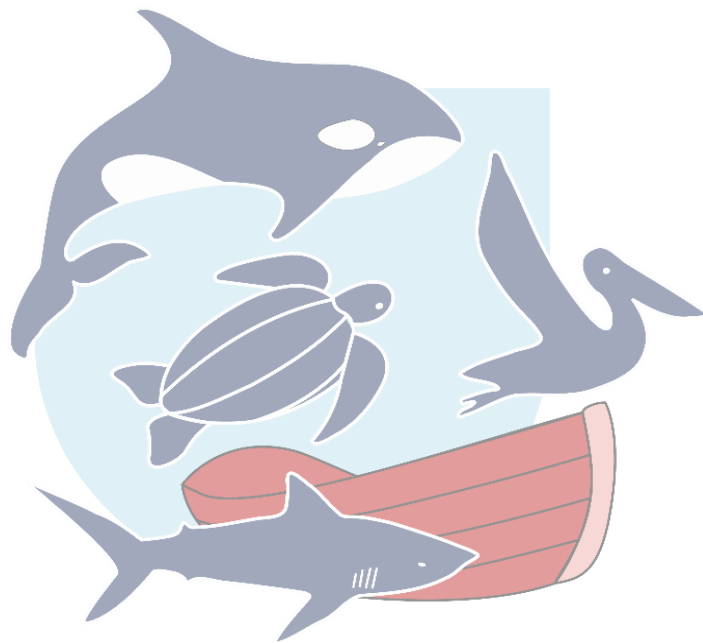


## **CAMAC workpackage 4: Knowledge enhancement for marine mammals and seabirds**

*Final report of CAMAC phase 1*

*The CAMAC project is co-financed by the Interreg Caribbean programme under the European Regional Development Fund.*



## Table of content

1.	CONTEXT .....	2
2.	OBJECTIVES .....	3
4.	PHASE 1 .....	4
	METHODOLOGY .....	4
	RESULTS .....	4
	<i>Survey methods</i> .....	4
	<i>Priority areas for transects</i> .....	8
5.	PHASE 2: WORKPLAN .....	12

# 1. Context

Caribbean marine experts have long stressed the need to improve knowledge and strengthen regional collaboration on marine mammal populations and their monitoring. The development of abundance and distribution maps of the species have notably been identified as priorities in the updated SPAW action plan for the conservation of marine mammals in the WCR<sup>1</sup>. The same is true for seabirds, for which the knowledge in the Caribbean and Guianas is still very low and mainly restricted to breeding colonies<sup>2</sup>.

Indeed, the assessment of animal populations distribution and abundance is a key to assess their state of conservation, to identify potential demographic decrease and to link the spatio-temporal dynamics of species with those of their threats<sup>e.g.,3,4</sup>. Acquiring species data at sea over a large region such as the WCR is a considerable challenge, but that appears necessary to identify the hotspots for species diversity, abundance, and most importantly the hotspots of overlap between species and human activities. It is based on such analyses<sup>e.g.,5,6</sup> that we can prioritise the areas where to put conservation effort and plan effective conservation measures in place, for a safe and long-lasting cohabitation between the species and the human activities.

Although enthusiastically mobilising scientists, MPA managers, NGOs and many interested citizens all around the Caribbean, the scientific monitoring initiatives on marine mammals of the region are often very local and unequal between territories<sup>7</sup>. Several countries are only establishing their list of species (Haiti, Jamaica, etc.) and only dispose of testimonials (often by fishermen) and of stranding data as sources of information on their species<sup>7</sup>. In this context, the regional assessment of marine mammal conservation status remains imprecise and some species may be exposed to higher risks than we think. In order to foster a regional evaluation of the species and promote their long-term monitoring, regional cooperation oriented towards the development of surveys in data and resource-lacking areas is crucial. Marine mammal monitoring is very difficult, as the animals spread over large distances and spend most of their time underwater. It then requires surveying far offshore with scientifically equipped boats, for long periods of time, often challenged by the weather, all which implies a thorough experience of the field and high costs. Therefore, marine mammal stakeholders of the Caribbean and Guianas seek collaboration frameworks to exchange feedback, to strengthen their capacity and to develop their field data acquisition. CAMAC thus aims at providing scientists and managers of the region with such framework for mapping the state of marine mammal populations and their threats at the regional scale (for which the only existing assessment consists in the Lifeweb project conducted in 2011<sup>7</sup>, of very low data resolution and now outdated) and furthermore, to foster a dynamic of large scale and long-lasting population monitoring.

---

<sup>1</sup> SPAW Species Working Group (2022). Update of the Action Plan for the Conservation of Marine Mammal in the Wider Caribbean Region. Tenth Meeting of the Scientific and Technical Advisory Committee (STAC) to the Protocol Concerning Specially Protected Areas and Wildlife (SPAW) in the Wider Caribbean Region. UNEP(DEPI)/CAR WG 43/INF 31

<sup>2</sup> See regional scientific references on <https://www.birdscaribbean.org/caribbean-birds/seabirds/seabird-resources/>

<sup>3</sup> Mannocci et al (2017) <https://doi.org/10.1111/cobi.12856>.

<sup>4</sup> Bonizzoni et al. (2019) <https://doi.org/10.1002/aqc.3148>.

<sup>5</sup> La Manna et al. (2020). <https://doi.org/10.3389/fmars.2020.542648>.

<sup>6</sup> Pennino et al. (2017) <https://doi.org/10.1371/journal.pone.0179686>.

<sup>7</sup> SPAW-RAC. (2020). Implementation of the Action Plan for Marine Mammals in the Wider Caribbean Region: A Scientific and Technical Analysis. Authored by Vail, C. and Borobia, M. UN Environment, Caribbean Environment Programme, Specially Protected Areas and Wildlife Regional Activity Centre. 158 pp.

As for seabirds, the context of current monitoring and the needs expressed by stakeholders are similar to those of marine mammals. The first regional seabirds census took place in 2023 where all the local stakeholders were invited to count the birds at the breeding colonies<sup>8</sup>. This initiative was coordinated by the NGO and stakeholders network Birds Caribbean. Monitoring initiatives are present in a few WCR territories, taking the form of colonies counting<sup>9</sup> and in fewer instances, on bird tagging programs<sup>10</sup>. However, the use of the marine habitat by the birds for certain behaviours like feeding is almost inexistent in the region. Seabirds' specialists recommend to focus the research efforts on identifying those feeding areas that are often located way offshore and may showcase interactions with fisheries or oil platforms<sup>11</sup>.

## 2. Objectives

Workpackage 4 of CAMAC project aims to **strengthen knowledge on the biodiversity, density, and distribution of marine mammals and seabirds** of the Wider Caribbean Region, to better identify the hotspots of interactions between the species and human activities. Through collaborative actions with Caribbean stakeholders, it also aims to foster scientific monitoring of the species at the regional level.

CAMAC phase 1 (2023) regarding work package 4 had three specific objectives:

1. **To develop collaboration** with local marine mammal and seabird stakeholders for collecting their insights and assessing their needs;
2. **To draw a regional scientific protocol** for collecting data on the diversity, density and distribution of marine mammals and seabirds;
3. **To identify the priority areas** where to collect data on species distribution and abundance.

CAMAC phase 2 (2024-2027) will aim at implementing the regional protocol in the priority areas identified during phase 1. The fieldwork will be implemented with local stakeholders to foster capacity building and empowerment at the local level. The collected data will be analysed together with the other available datasets on species and activities in a regional mapping analysis.

---

<sup>8</sup> Birds Caribbean regional census 2023: <https://www.birdscaribbean.org/caribbean-birds/seabirds/regional-seabird-census/>

<sup>9</sup> EPIC Seabird Breeding Atlas of the Lesser Antilles 2001-2019 <https://seamap.env.duke.edu/dataset/418>

<sup>10</sup> Movebank database of animal tracking data hosted by the Max Planck Institute of Animal Behaviour, which showcases several Caribbean seabird tracking datasets: <https://www.movebank.org/cms/movebank-main>

<sup>11</sup> Exchanges between CAMAC coordinators and Birds Caribbean, CNRS, MNHN, 2023.

## 4. Phase 1

### Methodology

Within CAMAC phase 1 (2023), the work on workpackage 4 was highly collaborative, focusing on the constitution of a regional working group and on the consultation of stakeholders through various ways. **Over 43 marine mammal experts and 6 seabirds' experts from 20 countries or territories of the Caribbean and Guianas participated** throughout the year to the working group and the two main workshops.

A first workshop at the Humpback Whale World Congress in March 2023 in Santo Domingo, Dominican Republic, called on the participants to express themselves on the needs of the region in terms of scientific monitoring and capacity building. The working group started to build from then, inviting members of the CARI'MAM and BirdsCaribbean networks. The working group conducted three meetings, two centred on the scientific survey methods and one on priority areas. The last decisions of phase 1 were taken during the round table organized at the final CAMAC workshop in November 2023 in Nassau, The Bahamas.

For all of these meetings, material was prepared to feed the discussion, such as maps, budgeted scenarios or examples of survey designs for allowing comparison. This material, as well as the meeting minutes, are available on demand.

In between, an online consultation was sent to over 200 stakeholders of the Caribbean and Guianas (CARI'MAM mailing list and BirdsCaribbean) to collect their knowledge and opinion on the existing and needed species distribution monitoring in their territory or country. The results helped to feed the discussions within the working group and are available on demand.



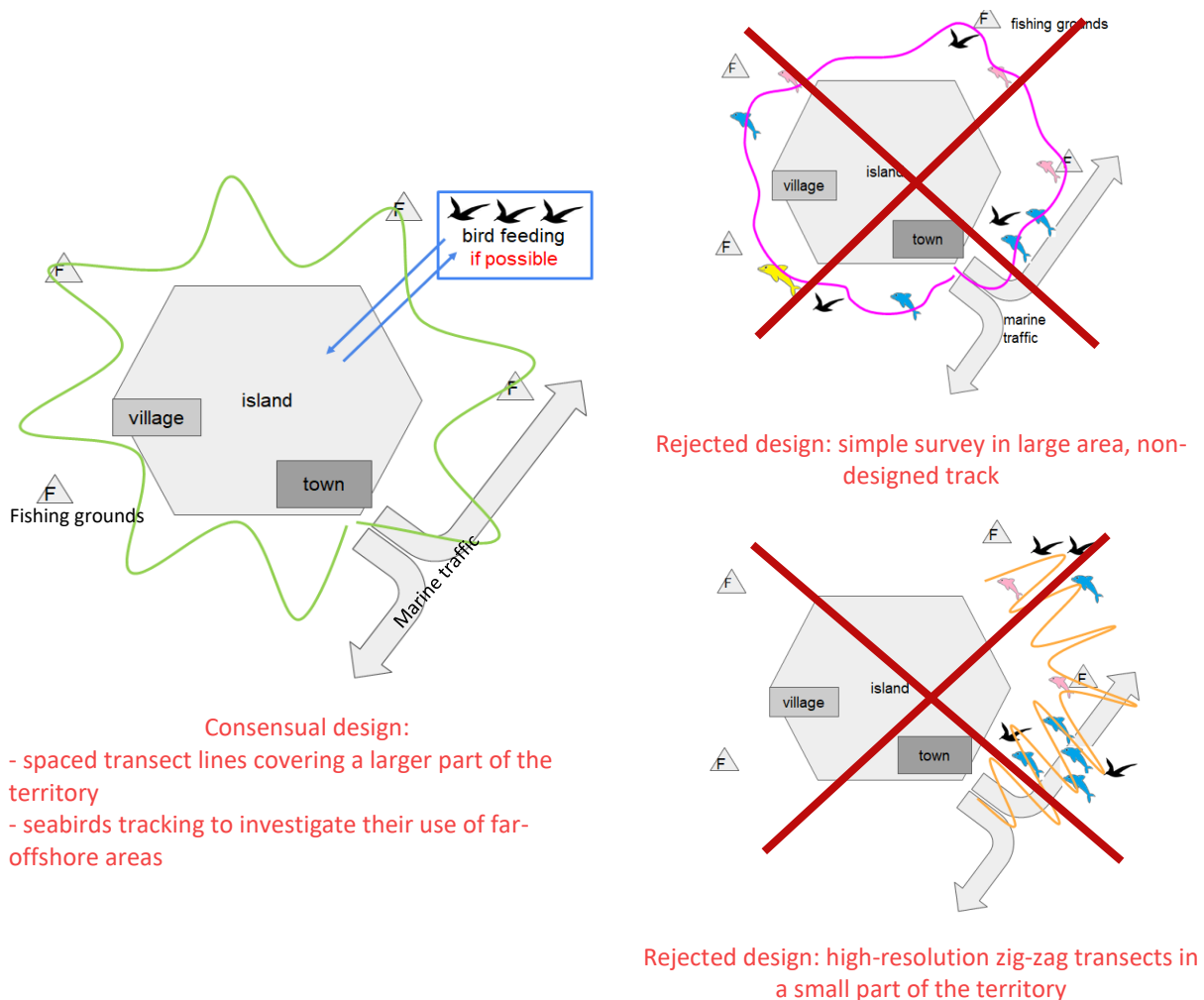
### Results

#### *Survey methods*

Based on the multiple discussions engaged with the working group, the CAMAC partners attending the final CAMAC workshop prioritized two methods to be implemented in phase 2 (Figure 1):

5. **A boat transect survey with an acoustic component** (towed hydrophone) to inventory homogeneously the species of both marine mammals and seabirds, from the coast to 30 NM;
6. **A seabird tracking program** for developing knowledge on seabirds' habitat use, and in particular, their offshore foraging hotspots that could interact with human activities.





**Figure 1. Survey design suggested by the Nassau workshop participants.**

### *Scientific protocol elements for boat surveys*

- Easy, low-cost and replicable at the regional scale

The protocol used should be accessible with a low financial capacity, so it can be replicated by partners in the long term in most countries. For instance, the type of vessel used should be of easy handling and available for renting in the region, such as monohull or catamaran charter sailboats.

The protocol should also be easy to follow but standardized enough so the results of the fieldwork surveys of several territories can be pooled in the analyses. As such, a common data entry tool should be shared by all the surveys, and the different types of data (species names, abundances and sizes, behaviours, human activities, weather, etc.) well-described so all the territories do fill the forms in the same way. The protocol could be based on standard transect observation procedures used across the world and scientifically published.

Capacity building is an important aspect to address for the good implementation and the replication of surveys. The CAMAC partners participating to surveys should be trained, ideally collectively, during a several-days' workshop including a fieldwork session, to notably: the identification of species and activities at sea (marine mammals, seabirds, fishing gear, etc.), the observation procedure and data entry method, the use of the acoustic equipment and of PamGuard.

▷ A designed survey track following the transect method

The survey design chosen for the boat survey in phase 2 represents a compromise between the spatial coverage of surveys and their data resolution (Figure 1). An effort spread over large areas with relatively low data resolution was favoured, to get an overview of the distribution of species in larger parts the territories rather than focusing on specific small areas. Partners also stressed out that it is important to design boat tracks before the surveys, with spaced transect lines that allow to cover homogeneously the habitats, in order to be able to estimate densities, and to replicate the survey in the future, based on the same design.

It was also mentioned that the design of transects needs to be done with caution and knowledge of the field, because the weather or sea conditions can impede following some tracks in several places, such as it happened for instance during the CARI'MAM transect survey in 2021. It is then recommended that the transect lines will be drawn in concertation with people that have good experience of the local sea conditions (local marine mammal stakeholders, skippers, etc.). A close balance will then have to be maintained between the objective of sampling the different territories in the same way to enable regional analysis, and the need to adapt the design to local conditions for better fieldwork implementation.

The transects will focus on the more “pelagic” marine mammal species, *i.e.*, the dolphins and whales. In consequence, “very coastal” species such as manatees and *Sotalia* will not be targeted by the surveys, but will be counted if encountered. These species are not shared by all the CAMAC scope territories, and their monitoring is easier to deploy and often already ongoing and well-managed by local organizations.

In order to cover homogeneously the different types of habitats, transects are often designed to cross a large range of bathymetry. Ideally, a transect survey would even prospect the entire maritime zone of interest. However, accessing offshore areas can be technically challenging, especially with lightly equipped vessels, and can get very costly. It was then preferred to restrain the surveys to areas between the coast and 30 nautical miles maximum (corresponding to roughly 6 hours of navigation for a boat at 5 knots). As the majority of human activities remain coastal, this footprint concentrates most of the suspected interactions and threats to species. This will still allow to cover high depths (>2000 m) in the Greater and Lesser Antilles.

▷ Acoustic monitoring

The use of a towed hydrophone array was the acoustic method the most favoured by the working group. This method enables to record continuously during transects and thus to collect visual and acoustic data at the same time. Complementing the visual effort by acoustic recording shows high importance for several cryptic species of marine mammals that spend very little time at the surface, such as the sperm whale and the beaked whales.

It was recommended to use a towed hydrophone array coupled with a click detector software such as PamGuard, which is open source and easy to use. This software automatically detects species acoustic emissions and identify the most probable taxon. Thus, outputs of acoustic detections have to be checked by a user but do not require a long and costly analysis of the recordings. That said, recordings of the surveys will be stored and could be analysed posteriorly.

As for the visual transects, the sampling of acoustic monitoring should be the same in the different territories covered, in order to allow the regional-scale analysis.

▷ Number of surveys and seasonality

The surveys should be implemented twice in each territory: once during the wet season and once during the dry season. Ideally, the surveys of several territories will be synchronized at maximum so to obtain a snapshot of marine mammals and seabirds' populations at the regional scale. Several boats and crews could then operate at the same time, but the use of one boat/one crew doing all the surveys can also be considered.

*Scientific protocol elements for seabirds tracking*

Seabirds are highly mobile, and can leave their colony for several days or even weeks to feed, going far offshore and even to distant countries. Tagging birds with transmitters is, according to the surveyed experts, the best way of finding out which areas they use and whether these areas are subject to threats. Interactions with human activities at sea are mainly of two types:

- ▷ Competition for preys with fishing boats (which often follow the birds to find the fish), and the accidental capture of birds in fishing gear;
- ▷ Attraction by lights at sea, caused mainly by large cruise ships, cargo ships and offshore oil platforms. Nocturnal birds such as petrels can be greatly disoriented by these lights and "fall" onto platforms, causing oil pollution, injury and mortality.

Scientists do not know the extent of those interactions in the Caribbean, and whether they disrupt breeding or cause mortality. In their view, the main need would be to carry out tracking surveys for a few key species, and in key territories, to investigate which areas the seabirds frequent and if they travel far at the regional scale.

The species identified by the Caribbean seabirds' stakeholders as of greatest interest, and which can provide representative examples of all the seabirds of the region, are:

- ▷ The brown pelican, representative and emblematic of the whole Caribbean, whose inter-island movements are unknown. Studying the brown pelican could provide an example of habitat use for the most "coastal" species.
- ▷ The tropicbird, and especially the red-billed species, for which the Caribbean accounts for a large proportion of global numbers. The tropicbird is very pelagic, and its monitoring can help identify the areas used by other pelagic birds.
- ▷ Audubon's shearwater, a member of the petrel and shearwater family (Procellariidae), whose behaviour is quite different from that of other seabirds, since they are mainly nocturnal.

Areas of interest for monitoring, outside the French West Indies (for which a tracking program is under development with the CNRS), would be Jamaica, Puerto Rico and Saba to the north, holding large colonies, and St. Vincent and the Grenadines and Venezuela to the south, hosting birds that are likely to interact strongly with commercial fishing and offshore platforms.



## Priority areas for transects

CAMAC geographical scope spreads from Jamaica in the north-west to French Guiana in the south-east, including the greater and lesser Antilles, Venezuela, the ABC islands, Caribbean Colombia, Guyana and Suriname. Given the budget allowed for the transect fieldwork in CAMAC phase 2 (~€650k), it will not be possible to conduct surveys across all of the CAMAC scope. Thus, candidate areas will have to be prioritized. After reviewing the results of the online consultation sent to stakeholders in September 2023, in which they were asked to draw and define the areas that they consider as priorities, the working group agreed on a set of criteria for prioritizing areas.

### Prioritization framework

The prioritization framework is composed of several criteria such as the level of knowledge of the country or the suspected level of threat in the area (Figure 2).

In general, will be favoured:

- Areas with knowledge gaps: in countries or territories where targeted surveys were never or rarely conducted;
- Areas with existing or suspected threats to species (high interaction with human activities);
- Areas holding a functional role for species and/or representing density or diversity hotspots;
- Areas where local stakeholders are responsive and willing to participate.

Moreover, the areas will be rejected:

- If local stakeholders are inexistent, because the involvement of local organizations is a prerequisite for the appropriation of the results and for fostering long-term monitoring in the territory;
- If they are situated beyond the 30NM limit, because of access difficulties.

CRITERIA	PRIORITY SCORE		
	3	2	1
Country: level of knowledge	Low	Medium	High
Suspected /existing threat level	High	Medium	Low/Unknown
Local stakeholders responsiveness		Very responsive	Responsive
Functionality		High/Medium	Low/Unknown
Diversity/density hotspot <i>marine mammals only</i>		High/Medium	Low/Unknown

+

**Area rejected if:**

- Inexistent stakeholder
- outside the 30NM

Figure 2. Area prioritization framework for boat surveys

As for now, the categorization of countries into three levels of knowledge for marine mammal populations (Table 1) was determined through the online survey sent in September (answered by: The Bahamas, Barbados, British Virgin Islands, Colombia, Dominica, Dominican Republic, Dutch islands, French territories, Haiti, Jamaica, Puerto Rico, St Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos, US Virgin Islands, Venezuela), completed by the review of research initiatives drawn during the evaluation of the Action Plan for Marine Mammals in the Wider Caribbean Region<sup>7</sup>.

**Table 1. Categorization of WCR countries into three levels of knowledge for marine mammal populations. \*territory or country not included in the INTERREG 21-27 cooperation program.**

High knowledge	Medium knowledge	Low knowledge
<i>Countries where there are various types of data on the species, that have conducted dedicated surveys and notably transect surveys.</i>	<i>Countries that have baseline data on the species, where a few dedicated studies have been conducted.</i>	<i>Countries where very few datasets on species are available, where information is only opportunistic, that never conducted dedicated studies.</i>
<ul style="list-style-type: none"> <li>- Dominica</li> <li>- Dominican Republic</li> <li>- French territories (Guadeloupe, Martinique, French Guiana, Saint Martin)</li> <li>- The Bahamas (North)</li> </ul>	<ul style="list-style-type: none"> <li>- British Virgin Islands*</li> <li>- Colombia</li> <li>- Dutch islands</li> <li>- Puerto Rico* and USVI*</li> <li>- St Vincent and the Grenadines</li> <li>- Suriname</li> <li>- Turks and Caicos</li> <li>- Venezuela</li> </ul>	<ul style="list-style-type: none"> <li>- Anguilla*</li> <li>- Antigua and Barbuda</li> <li>- Barbados</li> <li>- Grenada</li> <li>- Guyana</li> <li>- Haiti</li> <li>- Jamaica</li> <li>- Montserrat*</li> <li>- St Kitts and Nevis</li> <li>- St Lucia</li> <li>- The Bahamas (South)</li> <li>- Trinidad and Tobago</li> </ul>

Considering seabirds, according to Birds Caribbean stakeholders, most of the countries fall in the “low knowledge” category, except for:

- ▶ Turks and Caicos and French territories (Guadeloupe, Martinique, French Guiana): high knowledge
- ▶ Jamaica, Sint Maarten, St Vincent and the Grenadines: medium knowledge.

Stakeholders’ engagement has so far been described as the local organizations which showed interest in 2023 by actively participating to the working group and the final workshop. The following territories of the CAMAC scope area are listed for now: Barbados, Bonaire (NL), British Virgin Islands, Dominica, Dominican Republic, French Guiana (FR), Guadeloupe (FR), Grenada, Haiti, Jamaica, Martinique (FR), Puerto Rico, Saba (NL), St Maarten (NL), St Kitts and Nevis, Suriname, The Bahamas, Trinidad and Tobago, Venezuela.

### *Candidate areas*

Stakeholders of all of the Caribbean and the Guianas are currently being encouraged to submit candidate areas that will later be prioritized using the framework above.



The participants of the CAMAC final workshop in Nassau were invited to start submitting candidate areas. In total, participants shaped and described 29 areas in 11 countries or territories (Figure 3): ABC islands (Aruba, Curacao and Bonaire), British Virgin Islands, French Guiana, Guyana, Jamaica, Puerto Rico, St. Kitts and Nevis, Suriname, The Bahamas, US Virgin Islands and Venezuela. Some territories display duplicated areas (The Bahamas, Puerto Rico), because the drawing exercise was conducted twice (once with in-person participants, once with online participants). The designers of those areas will be asked to refine their contribution in order to reach a unique set of candidate areas per territory/country.



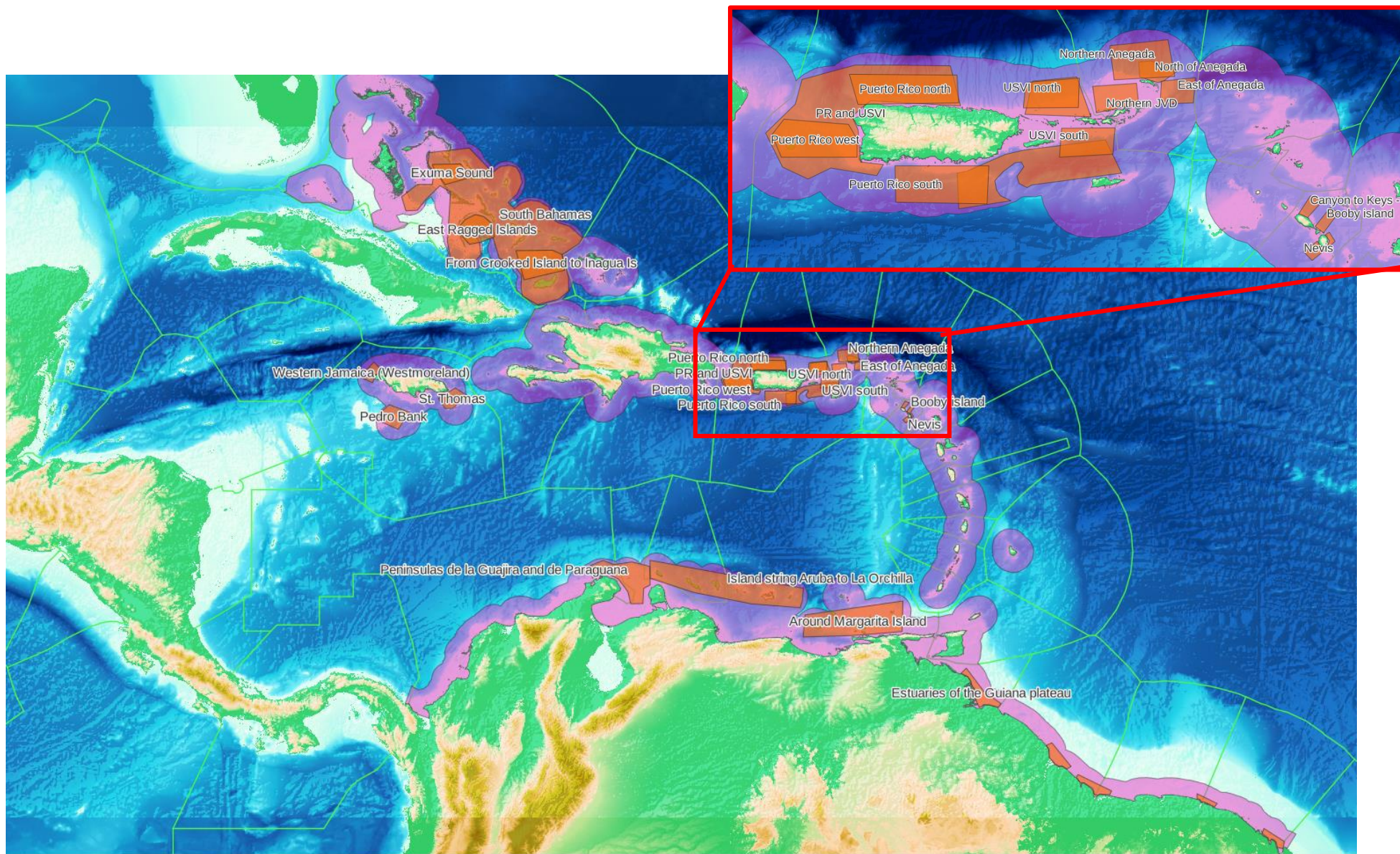


Figure 3. Map of the priority areas drawn during the Nov 4 workshop. The purple footprint represents the limits of potential areas to conduct campaigns.

## 5. Phase 2: Workplan

The objective of phase 2 will be to implement a regional survey, in the priority areas identified during phase 1, in order to assess the distribution and density of marine mammals and seabirds in the Caribbean and the Guianas plateau. A regional analysis will then be performed with the data collected during the survey, jointly with previously collected data. This will also feature an important capacity building component since many stakeholders will be trained and invited to participate to the fieldwork.

First, two standard fieldwork protocols (one for boat transects, one for seabirds tracking) will be designed, based on the methods the partners agreed on during phase 1. These protocols will be developed from widely used and scientifically published guidelines to study the abundance and distribution of species. Secondly, the local partners in the different territories will be trained to these protocols and will participate in the data collection in order to strengthen the skills of the territories involved. The results of the different surveys will be analysed using high-end methods to calculate animal density.

In parallel, existing data on the distribution of dolphin and whale species will be gathered through data sharing agreements. Both this existing data and the data collected through CAMAC will feed a large-scale mapping analysis over the Caribbean and the Guianas plateau. For selected species, analysis methods could take the form of habitat suitability models or kernel habitat use models. The final report will provide an updated cartography of the distribution and density of species.

Efforts will be deployed to disseminate this new knowledge and to enhance the engagement of various types of public: local and regional authorities, MPA and other maritime managers, academia and marine mammal and seabird specialists, schoolchildren and general public. For instance, the local authorities of the countries where fieldwork will take place will be invited to embark on surveys. As CAMAC considers raising awareness of youth as very important, an exchange between the scientific campaigns and the CAMAC partner schools is planned, with the diffusion of "logbook" videos in quasi-direct mode to classes. As this work aims at producing scientific results, scientific communications (peer-reviewed articles, conferences) will also be developed for the scientific community.

Finally, the results will be presented to the working group on marine mammals and seabirds, as well as during the final CAMAC workshop to attending stakeholders (scientists, MPA managers, local and regional authorities), in order to draw some operational conservation recommendations for marine mammals and seabirds.



## Contact

*Magali Combes*

*CAMAC project officer*

*Agoa Sanctuary, OFB*

[magali.combes@ofb.gouv.fr](mailto:magali.combes@ofb.gouv.fr)

*+596 (0) 6 96 00 00 00*

