BIOPAMA
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Fundação Tartaruga

BIOS CV

Cabo Verde Natura 2000

Training for the monitoring of biodiversity and protected areas in the Norte Natural Park and the Tartaruga Nature Reserve, Boa Vista Island, Cape Verde

Final Consulting Report

Dario Cesarini

This document was prepared in 2024, within the scope of the Project "*Community based sea turtle protection and biodiversity assessment as a baseline for future management of two protected areas on Boa Vista, Cabo Verde*" (hereinafter "BIOPAMA project"), funded by the European Union BIOPAMA Programme, under the tutelage of the Ministry of Agriculture and Environment (MAA), with implementing partners such as the Tartaruga Foundation, the Turtle BIOS. CV and Cape Verde Natura 2000.

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Capa – The group of trainees with the trainers at the southern end of Praia de Chaves, Boa Vista, Cape Verde, during a training trip in the field.

ACRONYMS

AP(s)	Protected Area(s)
BIOPAMA	*Biodiversity and Protected Areas Management*
CBD	Convention on Biological Diversity
CMBV	Boa Vista City Council
CMP	*Conservation Measures Partnership*
CVE	Cape Verdean Shields
CVN2000	Cape Verde Natura 2000
DMAA	Delegation of the Ministry of Agriculture and
Environment DNA	National Directorate for the Environment
And	This
EDM	Pocket Electronic Distance Meter
FOS	*Foundation of Success*
GPS	*Global Positioning System*
IMET	Integrated Management Effectiveness Tool
INDP	National Institute for Fisheries Development (INE)
	National Institute of Statistics
IUCN	*World Conservation Union*
MAA	Ministry of Agriculture and Environment
N	North
n/a or n/a	Not applicable
IN	*Network Attached Storage*
NGO(s) / NGO	Non-Governmental Organization(s)
	West
PoG	Management Plan
PdM	Monitoring Plan
PNN	Northern Natural Park (from the island of Boa
Vista) PoWPA	Work Programme on RNT Protected Areas
	Tartaruga Nature Reserve
S	South
SDTIBM	Society for Integral Tourism Development of Boavista and Maio SIG/GIS
	Geographic Information System
Tdr	Terms of Reference
TF/FT	Turtle Foundation / Fundação Tartaruga
TNC	*The Nature Conservancy*
WCS	*Wildlife Conservation Society*
WWF	*World Wildlife Fund*
ZDTI(s)	Integral Tourism Development Zone(s)

DEFINITIONS

It is proposed below a set of definitions, selected from among the proposals prepared by some of the largest conservation NGOs at the international level, in order to establish a common basis of understanding among all the partners participating in the development of this work.

Conservation target (by TNC): Specific element of the associated natural and cultural environments (e.g. species, ecological community, ecosystem, etc.) that the project has chosen to direct its activities.

Monitoring target: The conservation value, or threat, of which the status/evolution is intended through the monitoring activities. The monitoring targets may or may not coincide with the conservation targets.

Threat (by WCS): The spatial distribution and intensity of land and resource uses that have a direct effect on the species and habitats that the project aims to conserve.

Direct threats (by FOS): Factors that directly affect a conservation target (affect its conditions), or that cause its physical destruction.

Indirect threats (by TNC): These are the underlying causes that can potentially have a negative effect on conservation targets. It's the opposite concept of an "opportunity." It should be noted that one factor can be an indirect threat, or an opportunity depending on the context.

Threat analysis (adapted from WWF): An analysis used to identify all threats related to one or more conservation targets and ranks them hierarchically in terms of priority.

Attribute: The characteristic you want to monitor to understand the quality of the status/evolution of the monitoring target.

Baseline (by WWF): The reference point that the project's monitoring activities refer to to determine changes in measured attributes over time.

Adaptive management (adapted from FOS): A process of integrating project planning, management, and monitoring to test hypotheses, adapt ongoing activities, and learn for future projects.

Indicators (by CMP): Units of information measured repeatedly in time that document changes in specific conditions.

Methods (by WWF): Specific approaches to recording, technical/technological, or measurement activities.

Conceptual/situational model (by WCS/CMP): The visual representation that renders explicit the design goals, conservation objectives, causal connections with the threats, and priorities in the interventions aimed at conservation.

Monitoring (Sriskanthan *et al.*, 2008): is the repeated observation of a system with the aim of identifying evidence of change. Monitoring can be used to quantify changes, identify their causes, and define acceptable levels of change.

Objectives (by TNC): A specific statement that explains what the results, or intended impacts, of a set of project activities are. A project usually has more than one goal. Objectives can be set either for the status to be achieved for a conservation target or for the abatement of a threat. If a project is well conceptualized and planned, meeting its objectives should lead to meeting its goals.

Opportunities (adapted from CMP): The biological, physical, social, economic, and political potentials that support, or can support, the achievement of conservation objectives.

Monitoring Plan (PdM) (by TNC): A blueprint of all the steps that a project team has to implement to ensure that the project is in line with its objectives (e.g. manage efficiently and effectively). A PdM identifies the project's audience, what they need in terms of information, identifies the strategies, methods, indicators to be used to collect the data, and when, who, where, will collect them.

Stakeholders (by WWF): Individuals, or groups with a direct, relevant and defined interest in the territory, or one or more elements of the set of natural resources interested in the project that therefore have an interest in the project itself.

***Data Trend* (** adapted from WCS): A set of data used to compare the data collected in order to determine whether or not changes are occurring, and whether or not they are related to project management activities.

CONTENTS OF THE REPORT

1. INTRODUCTION, CONTEXT, AND PLANNING

At the global level, protected areas (PAs) represent a relevant portion of the terrestrial environment and an increasing fraction of the marine environment. This relevance is the result of a growing commitment at the international level, by national and local governments, communities, private individuals, *the non-profit* sector, towards the protection of biodiversity, environmental services and associated cultural values.
Increasingly, countries are seeking information on the status and trends in the management of their PAs as a commitment made within the framework of Conventions and other instruments at the international level. At the same time, peoples are investing their resources in the creation, operationalization and implementation of PAs, certainly through national and local governments, but also through direct, voluntary support in different forms. It is their right to know that these territories, and the investments related to their conservation, are well managed. The combination of these internal and external needs has led to a rapid increase in interest in the theoretical and practical issues of monitoring and evaluating the management effectiveness of protected natural areas.

The island of Boa Vista is characterized by a relevant ecological importance, as it has a wide variety of marine species, and some endemic and endangered terrestrial species. Boa Vista's waters are home to populations of tuna and sea turtles, and other species of international importance. Also noteworthy is the island's role as an important site for migratory bird species, with the presence of sites protected by the Ramsar Convention. Despite the quality of these values, the island's natural resources are threatened by various factors such as those related to climate change, mass tourism, and an articulated set of anthropogenic disturbances.
The set of APs on the island created in 2003 (Decree-Law No. 3/2003 of 24 February), consists of 14 APs (Figure 1).

Figure 1: Location of the protected areas of the island of Boavista (the map does not consider the four APs that are found on islets around the island). Cartographic elaboration by A. Brusaferro.

The Northern Natural Park (PNN) (Figure 2) and the Tartaruga Natural Reserve (RNT) (Figure 3), the target of this work, are part of the insular network of PAs.

Figure 2: Location of the Northern Natural Park. Cartographic elaboration by A. Brusaferro.

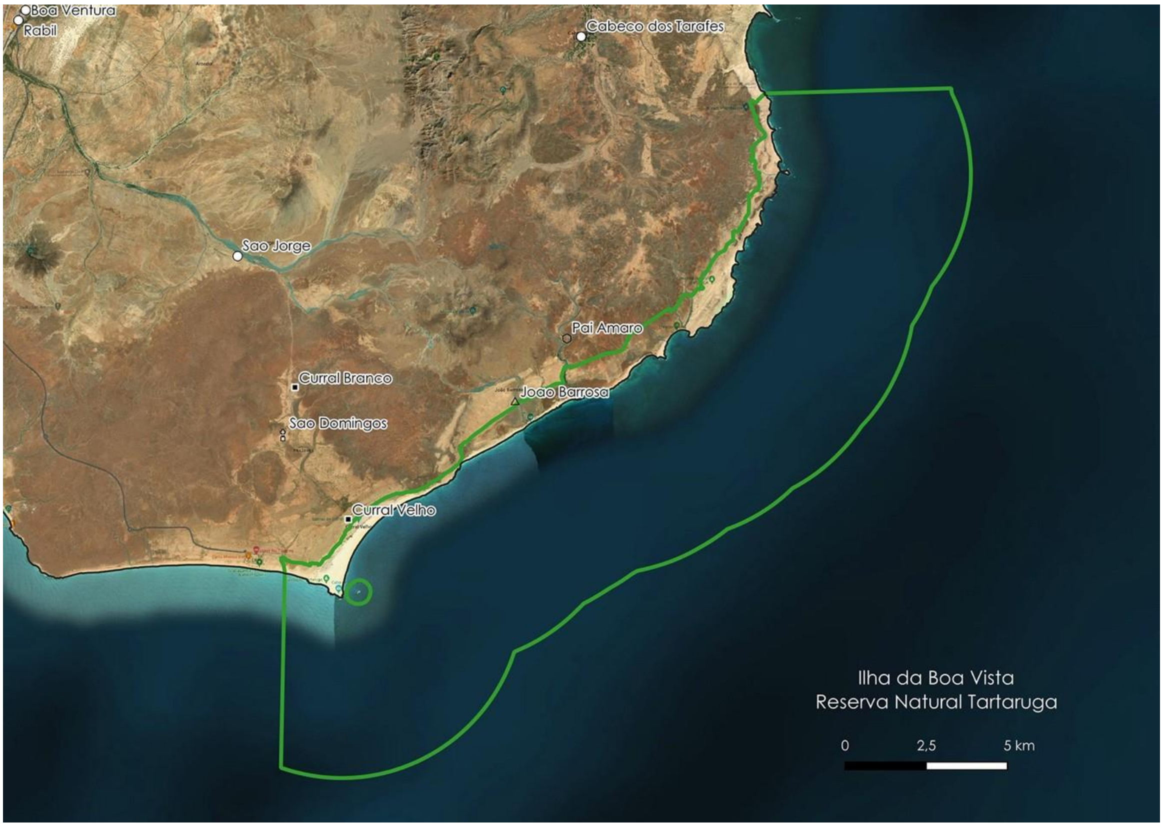


Figure 3: Location of the Tartaruga Nature Reserve. Cartographic elaboration by A. Brusaferro.

In 2021, the two PAs were the subject of an evaluation by the Integrated Management Effectiveness Tool (IMET). In this context, a large gap in data and knowledge has been identified. Following this assessment, priority actions were identified to address these knowledge gaps and to support local and international biodiversity conservation objectives, with one of the first planned steps being the collection of baseline data in the two PAs.

The need to establish a monitoring system in PAs as a basic tool for assessing the quality of land management, and more specifically of natural resources and biodiversity, is defined by a set of national policy reference tools such as:

⇒ The elaboration and implementation of monitoring plans, or similar tools, for one or a complex of PAs is a standard required by the major international Conventions to which Cape Verde is a signatory. In this case, the Convention on Biological Diversity (CBD) is particularly relevant, especially through its Work Programme on Protected Areas (PoWPA).

⇒ The National Strategy and Action Plan on Biodiversity 2014-2030 (MAHOT, 2014), provides for activities aimed at the preparation and implementation of biodiversity monitoring plans (e.g. National Priority 6: "*Increasing knowledge, monitoring and evaluation of biodiversity;"* Activity 5.1 "*Develop and implement plans for the exploration and monitoring of priority marine resources*"; Activity 7.2: "*Design and implement priority habitat monitoring programmes.*"; Activity 9.1: "*Identify biodiversity and ecosystems providing priority essential services, of particular value to biodiversity and the most vulnerable populations (women and the poorest) and promote their protection and monitoring.*").

⇒ The National Strategy for Protected Areas (MAHOT-DGA and PCSAPCV, 2013) provides for Action 4.1.2: "*Develop and implement an efficient system for long-term monitoring of the results and impacts to be achieved through the National Network of Protected Areas and its sites.*More specifically this action provides (Measure 2) to "*Prepare and implement monitoring plans for each AP, or island groups of PAs.*"

Fundação Tartaruga, Bios.CV and Cabo Verde Natura2000 are Cape Verdean non-governmental organizations that work on the protection and conservation of biodiversity on the island of Boa Vista. With the financial support of the European Union program BIOPAMA and the tutelage and institutional collaboration of the Ministry of Agriculture and Environment (at the island level through its Delegation), these NGOs implement the project "*Community protection of sea turtles and biodiversity assessment as a basis for the future management of two protected areas in Boa Vista, Cape Verde*." The project has four objectives:

Outcome 1: Continue the protection of a nesting site for loggerhead turtles of global significance.

Outcome 2: Collect baseline data on the species, habitats, ecosystems, resources and pressures present in PAs and increase local people's knowledge and awareness of PAs. Outcome 3: Improve the livelihoods of local community members through direct employment as rangers, improving the capacity of local farmers to grow climate-resilient crops.

Outcome 4: Increased awareness and recognition of PA at national and international levels.

This capacity-building initiative was developed within the scope of Outcome 2 of the project, aimed at providing the local context with the necessary knowledge to:

1. the collection of data on a priority set of monitoring targets present in the PAs, selected by the implementing partners;
2. shared tools that constitute the first functional core to develop a comprehensive PA monitoring system.

It is in this general framework that the capacity building work described in this report has been carried out.

1.1 SCOPES AND OBJECTIVES

The geographical scope of this work was defined as the set of natural resources, environmental services, and associated socioeconomic dynamics that meet, or use, the terrestrial and marine territories of the PNN and the RNT.
In the case of training/monitoring activities that are seriously affected in their effectiveness, due to their limitation within the geographical scope defined above, the geographical scope of reference has been extended to the entire island of Boa Vista.

According to the indications of the partners of the initiative, **the *primary* audience** of the information produced through the tools created with this work is that of the technical-institutional partners at local and national level.
The *secondary* audience of the information produced through the tools created with this work is that of international partners, especially current and potential donors of conservation and sustainable development activities on the island.
The *tertiary* audience of the information produced through the tools created with this work is that of the communities residing and users of resources of the two target PAs.

According to the **Terms of Reference of this consultancy**, its objectives are:
⇒ *Provide training and tools that enable high-quality, long-term monitoring.*
⇒ *Ensure the longevity and sustainability of the project through the transfer of knowledge through the creation of guides and templates.*
⇒ *Create a reference database of the biodiversity present in the target PAs, and a viable monitoring plan for the future.*

In addition, the Terms of Reference of this consultancy also refer to the need for the consultant to support the teams of the organizations involved at the local level in:
Train a team of local technicians: coordinators, environmental guards and volunteers to carry out baseline biodiversity surveys.
Create a database of abundance and distribution of:
- a. *Species*
- b. *Habitats – beaches, wetlands and salt pans*
- c. *Ecosystems*
- d. *Pressures*
- e. *Illegal activity*

Use of the database for the creation of maps and georeferencing of areas.
Creation of protocols to continue monitoring the main indicators. Identify, monitor and quantify future trends.

The purpose of this report is to provide a description and explanation of how the objectives set by the consultancy, and the technical support needs evidenced by the ToR, were met through the consultant's work.

1.2 EXPECTED PRODUCTS

The **expected products indicated by the Terms of Reference of this consultancy** are:
1. *Comprehensive training, including workshop and in the field, on monitoring key biodiversity indicators.*
2. *Protocols for collecting a baseline database on species, habitats, and activities (both harmful and beneficial).*
3. *Protocols for data collection for each of the key indicators specified in Annex 1.*
4. *Final report of the work completed within one month of leaving Boa Vista and recommendations for the future.*

The development of the "elements" indicated in Annex 1 of the ToR, and the training of trainees that were part of the teams for the implementation of the monitoring activities, was explicitly indicated by the project coordination group, since the *kick-off meeting,* as the key and priority product expected by the consultant's work. Annex 1, specifying that "*indicators are open to suggestions and adaptations*", includes the following "key indicators":

1. To evaluate the impact of crows (*Corvus ruficollis*) on the fauna in PAs. (Behavioral Study)
2. To evaluate and map endemic vs invasive plant species e.g. Date palm (*Phoenix atlantica*), Tarrafe (*Tamarix senegalensis*) and Fig tree (*Ficus sycomorus* ssp. *gnaphalocarpa*) vs Acacia (*Acacia americana*), over time. 3. Monitor precipitation. 4.
To evaluate the abundance and distribution of free grazing cattle in PAs. 5.
Evaluate the circulation of vehicles on the beaches, dunes and inside the PAs, quantifying the number of vehicles and people. 6. Quantify shark
catches, based on remains found and interviews with fishermen. 7. Quantify the
extraction of buzio (mounds of discarded whelk shells). The intervention
areas include: Baía das Gatas, Praia de Ervatão, Porto Ferreira and Derrubado. 8.
Identify indicators of long - term climate change. (For example: sea air temperature, sand, pH of the sea/salt pans etc). 9. Identify long - term key/indicator species.

According to the consultant's technical analysis, the list in Annex 1 incorporates a mixture of ecological monitoring targets and ideas for monitoring methods - without providing "indicators" per se - to be measured using monitoring methods developed for this purpose.
The contents of Annex 1 will be discussed in detail in the respective methods sections of Chapter 3.

1.3 TEAMS

Table 1 presents a summary table of the professionals involved in this consultancy.

From the first phases of this consultancy (email of November 2, 2023), the consultant presented to project manager Kate Yeoman the possibility of enabling a *win-win* collaboration at no cost for the project, with biologist Andrea Brusaferro, on a trip to the island of Boavista as part of his PhD at the University of Camerino (Italy). Andrea's contribution was presented as an obvious potential asset for the training, considering his specific background in monitoring populations of species of the *genus Corvus* (one of the monitoring targets indicated in annex 1 of the ToR), and his advanced knowledge of software tools such as *Qgis* and *Qfield*, as his potential more concrete technical contributions.
The opportunity presented was taken advantage of by the project. Andrea Brusaferro's specific contributions to training can be viewed in the chronoprogram available in the project's GDrive folder: https://docs.google.com/document/d/14GQ9hd9jMe5I4H-kAkxmhJfiH8Y3msuz/edit?usp=drive_link&ouid=105992151894426773014&rtpof=true&sd=true

Table 1: Summary table of the professionals involved in this consultancy.

Name	Organize.	Position	Trainers	Coordination	Trainees
Dario Cesarini		Consultant			
Andrea Brusaferro		Guest Expert			
Kate Yeoman	FT	Project Manager			
Maria Medina	CVN2000	Point focal CV Natura 2000			
Katia Lopes	Bios.CV	Focal point Bios.CV			

Name	Organize.	Position	Trainers	Coordination	Trainees
Ivone Delgado	DMAA	DMAA Focal Point			
Inilton Tavares	FT	Coordinators of fieldwork			
Nelson Semedo	Bios.CV				
Kenydjeer Rodriguez	CVN2000				
Ailton Andrade	FT	Assistants of fieldwork			
Diana Semedo	Bios.CV				
Rafaela Tavares	FT				
Emílio Landim	FT				
Jailson Martins	FT				
Jorge Semedo	CVN2000				
Ruben Taccola	Bios.CV				
Silverio Santos	CVN2000				

1.4 WORK PLAN IMPLEMENTED

The work was carried out between the end of October 2023 and the middle of March 2024. The consultant's field mission took place between 20 January and 18 February 2024. The training course was implemented between January 22 and February 17, 2024.
The main work steps implemented within the scope of this consultancy are presented in Table 2.
The detailed syllabus of the training course with an indication of the contents of the classes, the field trips, the trainers and trainees involved, and the materials used can be found at the following link: https://docs.google.com/document/d/14GQ9hd9jMe5I4H-kAkxmhJfiH8Y3msuz/edit?usp=drive_link&ouid=105992151894426773014&rtpof=true&sd=true

Figure 22: Training session for the introduction of trainees to the permanent quadrant method for monitoring introduced plant species.

Table 2: Main stages of consulting work.

Period	Local	Activities	Deliveries
October 27 2023	Remote	Submission of the first draft of the consulting contract and officialization of the signing of the position. Beginning of the work of preparation of the training.	
November 16 2023	Remote	*Online kick-off meeting* with the coordination team of the BIOPAMA project.	
Since 16 November 2023, until January 9, 2024	Remote	Definition of methodological outlines and related tools for six data collection methods (in fact seven methods were prepared, see § 3.6), on monitoring targets selected by the project coordination team. Work developed by the consultant and the invited specialist, through a technical exchange with the project coordination team.	- Sketches of methodological sheets; - Sketches of land sheets; - Database sketches.
November 20 2023	Remote	Delivery of the first draft of the training chronoprogram.	First draft of the training chronoprogram
November 22 2023	Remote	Signing of the contract by the Parties.	Contract signed
November 24 2023	Remote	Delivery of outlines of basic tools for the conceptualization and structuring of monitoring systems in PNN and RNT PAs.	- Sketches of situational models for the RNT and the PNN; - Sketches analysis of priority monitoring of conservation targets of RNT and PNN; - Outline of environmental monitoring methods currently implemented on the island and other potentially priority ones.
Since 1 from December 2023, until 17 from February 2024	Remote and in Boavista	Organization of training logistics. Work developed by project manager Kate Yeoman, in collaboration with the consultant and the project coordination team.	
8 from January 2024	Remote	Delivery of the final draft of the training chronoprogram. Adapted version during training implementation to meet the changing terrain and logistical conditions.	Final outline of the training chronoprogram
Since 22 from January, until 17	Boavista	Implementation of the training course according to the planned chronoprogram.	Training programme implemented (Point 1. of the results expected by the ToR).

Period	Local	Activities	Deliveries
from February 2024			
Since 20 from January, until February 24	Boavista and in remote	Definition and preparation of collection and analysis tools of GIS data, through the use of Qgis software and Qfield. Work developed hair consultant and or Invited expert, based on project needs.	For the methods where it was relevant: - Final sketches of field data collection systems at the base of the Qfield application; - Final sketches of GIS analysis on the basis of Qgis software.
February 24 2024	Remote	Delivery of methodological sheets, projects and cloud repositories, alphanumeric data collection and analysis tools and GIS for the implementation of six data collection methods, on monitoring targets selected by the project coordination team.	- Final drafts of methodological sheets and technical support sheets; - Final sketches of land sheets in Excel and Qfield base; - Final sketches of databases in Excel and Qgis databases; - OneDrive project; - Cloud Qfield project. - Associated smaller tools. (Points 2 and 3 of the results expected by the ToR).
8 from March 2024	Remote	Delivery of the Final Consulting Report.	Final Consultancy Report (Item 4. of the expected results by the ToR).

2. CONTEXTUALIZATION TECHNIQUES TOOLS

With monitoring activities, a set of real-world partners cannot track changes in all possible natural resources or related threats of a territory that spans a few thousand hectares.
The easiest thing in preparing an environmental monitoring scheme is to list all the possible indicators of environmental variables. At the same time, the most important (and difficult) process is to consistently evaluate and select a relatively limited number of indicators that show the best cost/benefit ratio for the specific context.
Clear mechanisms for prioritizing issues should be incorporated into the preparation of the monitoring programme, recognising that some issues, or elements of the context, are more relevant, or urgent, than others.
The elements of the context need to be related to each other, recognizing that there is the possibility of grouping them together on the basis of overlaps between the threats that target them, and the solutions to common problems.
In this type of work, it may happen that indicators are selected that are not realistic, that are too difficult to be measured regularly with the available capacities and resources, or that prove to be incapable of measuring the impacts of management activities. On the contrary, it is the consultant's agreement, expressed to the partners involved in the BIOPAMA project, that the indicators used on the island of Boavista should be able to reduce the data collection effort to the minimum possible levels in terms of costs, rationalizing the use of the limited technical and financial resources available, while ensuring the acquisition of the most relevant and strategic information to understand the trends and implement an efficient management of the natural resources of the island, and more specifically of its PAs.

The reference framework for the evaluation of the effectiveness of PA management developed by the IUCN (Hockings *et al.*, 2006), also adopted by the CBD, is developed in the evaluation of six strands, namely:

1. Context
2. Planning
3. Inputs
4. Processes
5. Goods
6. Impacts

Ideally, each of these strands should be monitored and evaluated if a complete knowledge of the management effectiveness of the PA(s) under consideration is to be achieved.

Due to the priorities defined within the scope of the BIOPAMA project, the training initiative related to this consultancy had an almost exclusive focus on one of the six strands listed above, i.e. the Impacts (6.) (i.e. follow-up over time of ecosystem variables).
Most of the other strands listed above are hardly considered in the framework of this capacity building initiative.
Regarding the Context aspect (1.), although it had not been considered within the scope of the ToR of the consultancy, since the *kick-off meeting*, the consultant highlighted to the project coordination team the need to implement at least some basic technical analyses, for the identification of priorities and existing gaps in terms of ecosystem monitoring of the PAs targeted by the BIOPAMA project.
It was in this way that the consultant developed some basic tools, useful for both, the contextualization of the training work of the local teams to be implemented, as well as the contextualization of the trainees in the framework of the ecosystem monitoring work that they will be called to develop. These include:

a. Situational models of the two target APs;
b. Priority analysis of conservation targets for monitoring.

2.1 SITUATIONAL MODELS OF APS TARGETED BY THE PROJECT

The concept of "context" in the case of the IUCN methodological approach includes the values that PA encompasses, the threats that affect them, the opportunities to develop it better, the *stakeholders* who interact with it, and the administrative and political environment that influence its management.

As evidenced in Section 1, in relatively recent times (2021) the PNN and the RNT were the subject of a participatory evaluation stage (Fundação Tartaruga, 2021a; 2021b). In this context, a work of compilation and discussion of data inherent to the ecological and sociocultural context of the island was developed, with a special focus on these two PAs.
Additionally, in 2018, within the framework of the Bio-Tur project (MAA/UNDP/GEF), the same consultant developed a preliminary participatory analysis with *local stakeholders* on values, threats and contributing factors, which targeted other PAs on the island of Boavista, which nevertheless have evident similarities with the PNN and the RNT.

It was therefore natural, in the development of this analysis, to take advantage of the data and information collected and discussed in the previous evaluations.

Based on this information and the methodology provided by the *Open standards* developed by the *Conservation Measures Partnership* (CMP, 2020) and using its software tool *Miradi Share*, two situational models were developed, one for each target AP, which schematize and relate the conservation targets, the direct threats that affect them and, in a more limited way, the contributing factors of these threats.

The result of the compilation work of the documentary database was successively validated by collecting subsidies remotely by the coordination team of the BIOPAMA project, and on the first/second day of the training course, in the form of a workshop by the trainees who, in most cases, have already worked in at least one of the two target PAs.
The consultant considers this initial work of discussion, sharing and collective conceptualization on the conservation issues of the target PAs, as a fundamental starting stage for the contextualization of the trainees within the training process that involved them throughout the following month.

The situational models for PNN (Figure 4) and NTN (Figure 5) are presented below.

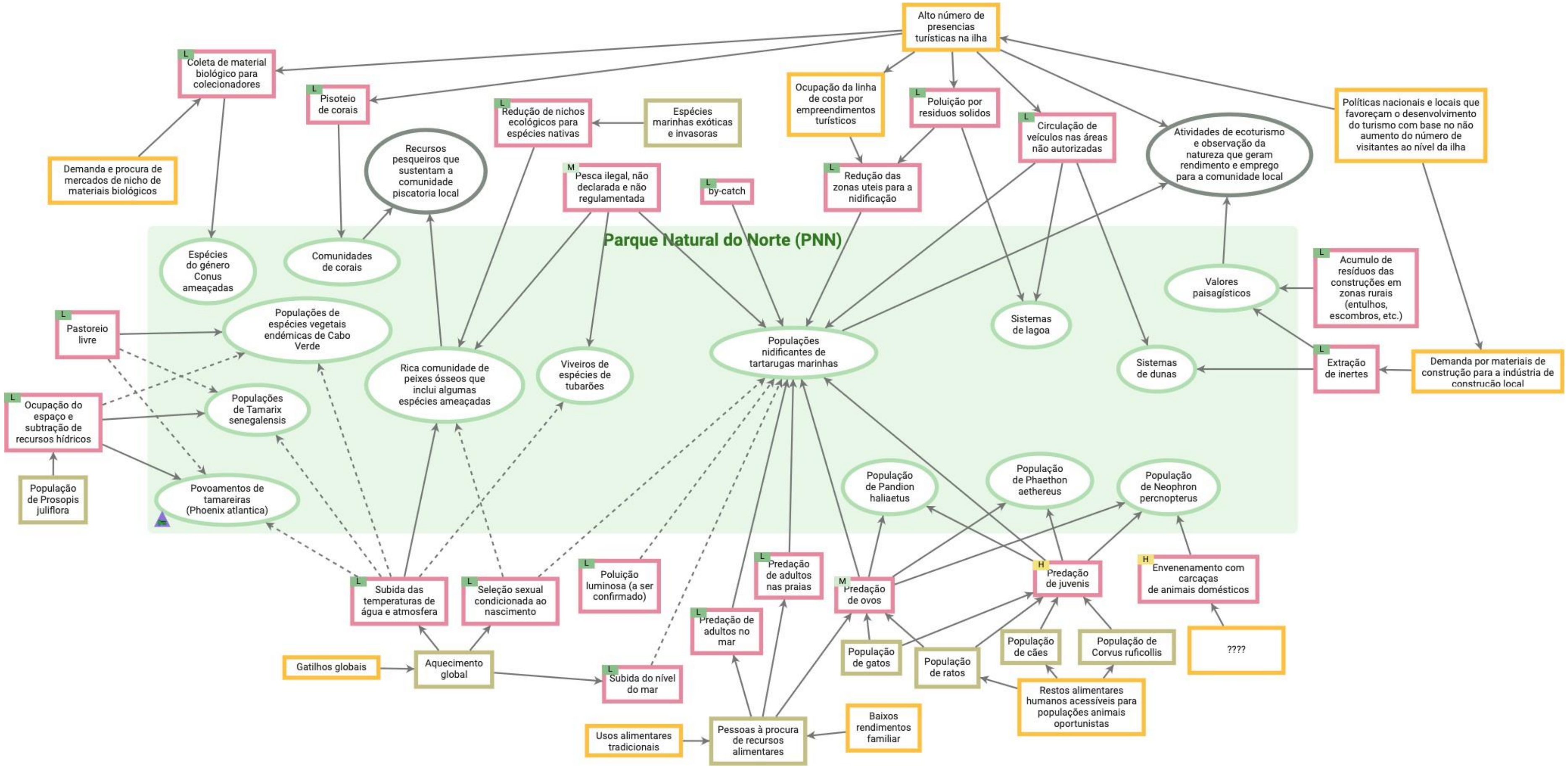


Figure 4: The **situational model of the Northern Natural Park**, which represents the geographic scope (green rectangle), the main conservation targets (light green circles), human welfare targets (dark green circles), the direct threats (pink rectangles), the human contribution factors (yellow rectangles), biophysical contributing factors (military green rectangles), the right relationships between these (continuous arrows), the uncertain relationships between them (punctuated arrows).

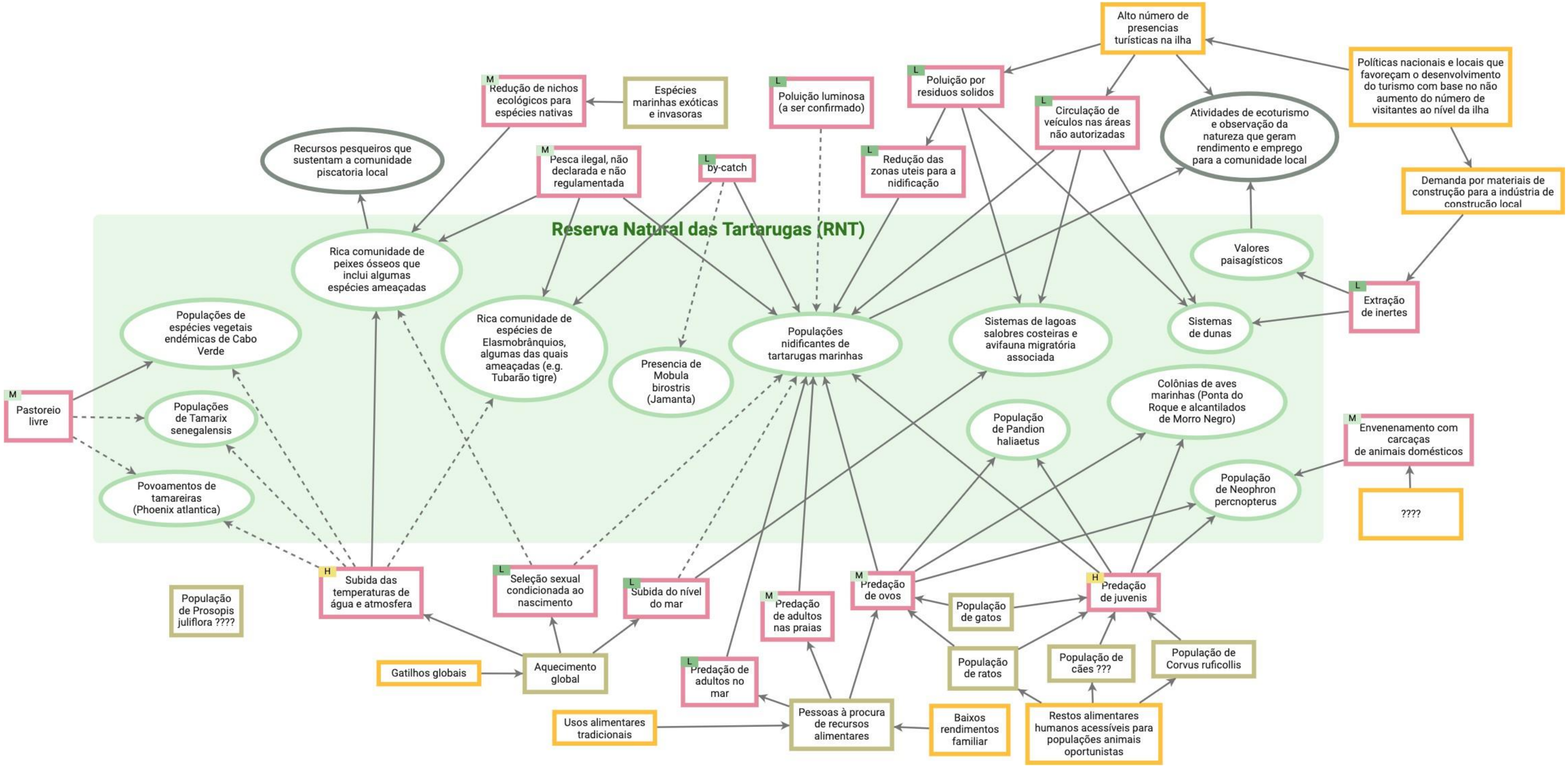


Figure 5: The **situational model of the Turtle Nature Reserve**, which represents the geographic scope (green rectangle), the main conservation targets (light green circles), human welfare targets (dark green circles), the direct threats (pink rectangles), the human contributing factors (yellow rectangles), biophysical contributing factors (military green rectangles), the right relationships between these (continuous arrows), the uncertain relationships between them (punctuated arrows).

2.2 PRIORITY ASSESSMENT OF CONSERVATION TARGETS FOR THE IMPLEMENTATION OF MONITORING ACTIVITIES

Conservation targets (sometimes called "conservation fundamentals") are the basic elements commonly used to set targets, develop conservation activities, and measure the management effectiveness of a PA. In principle, the conservation of the set of conservation targets of an AP should ensure the conservation of all the natural resources of the site.

The natural conservation targets identified with the development of situational models (§ 2.1), plus some successively identified, were evaluated by adapting and developing the methodology proposed by Cesarini (2008b).

Conservation targets have been given a priority level for their monitoring, assessed against a set of eight criteria. For each criterion, a scoring scale was structured into four levels, assigning a score of 3 to the predefined characteristics related to the highest monitoring priority level, and a score of 0 to the lowest priority level. Each criterion has a "weight" related to its importance compared to the other criteria. The weight coefficient can vary between 1 and 3. The total priority level of each conservation target is the sum of the scores the target received for each evaluation criterion, each multiplied by its weight.

The consultant developed his assessment based on his knowledge of the sites, the island of Boavista, nature conservation in Cape Verde, as well as the scarce documentary base available.

The consultant's assessment outline was indirectly validated through the results of the similar group work that the trainees implemented during the first days of the training course. For this purpose, the group of trainees was divided into two subgroups; each subgroup included the trainees who best considered to know one of the two target PHCs (PNN or RNT). Each subgroup of trainees developed autonomously the evaluation methodology presented above, considering the context of a specific PA.

At the time of the return of the results, for each score of the subgroup in question that differed materially from the score assigned by the consultant in his evaluation, the consultant asked the group to justify and discuss its evaluation choices. In all cases where the motivations of the subgroups of trainees were convincing, the consultant changed the score previously assigned by him/her, equating it, or approximating it, to that proposed by the subgroup of trainees. The results of this evaluation process are presented in Tables 3, 4, 5 and 6.

The target represented by the coral communities was not evaluated due to lack of the minimum knowledge for its evaluation, even if it is approximate.

Table 3: Table for assessing the priority of PNN terrestrial conservation targets, developed on the basis of the methodology presented in this Section.

Conservation Target	Global rarity and national	Local decline acquaintance	Value to processes Ecological	Responsiveness of indicators	Management conflicts Local	Economic value Direct (local)	Local Alternatives of management	Interest of the public	Total
Date palms (*Phoenix atlantica*)	3	2	3	1	2	1	3	2	**36**
Endangered plant species (excl. *Phoenix Atlantic)*	3	2	2	1	1	1	2	1	**29**
Dune systems	2	1	3	1	3	1	1	2	**28**
Reedtail (*Phaethon aethereus*)	2	2	2	2	1	1	1	2	**26**
Fig Tree (*Ficus sycomorus*)	2	3	2	0	0	1	2	1	**26**
Tarrafe (*Tamarix senegalensis*)	2	1	3	1	1	1	2	1	**25**
Winch (*Pandion haliaetus*)	1	2	2	2	1	1	1	2	**23**
Endangered terrestrial reptile species (*Tarentola boavistensis* VU, *Hemidactylus NT boavistensis*)	3	2	2	3	0	0	0	0	**22**
Ecosystems of coastal flooded lagoons	2	1	3	1	0	0	2	1	**21**
Landscape values	1	1	0	2	2	0	3	2	**20**
Species of birds	0	1	1	2	0	0	1	1	**10**
Relative weight of the criterion	***3***	***3***	***2***	***1***	***2***	***2***	***2***	***1***	

Table 4: Table for assessing the priority of marine conservation targets of the NAP, developed on the basis of the methodology presented in this Section.

Conservation Target	Global rarity and national	Local decline acquaintance	Value to processes Ecological	Responsiveness of indicators	Management conflicts Local	Economic value Direct (local)	Local Alternatives of management	Interest of the public	Total
Elasmobranch community and its nurseries: Cat shark (*Ginglymostoma cirratum*), Bull shark (*Carcharhinus taurus*), Hammerhead Shark Species	3	3	3	1	3	3	3	3	**46**
Whiting (*Mycteroperca fusca*) and other species of endangered demersal fish	3	2	3	2	3	3	3	3	**44**
Sea turtles (nesting)	3	0	3	0	3	3	3	3	**36**
Sea turtles (feeding)	3	2 (uncertain)	3	1	2	1	2	2	**34**
Buzio goat (*Persististrombus latus*)	0	3	2	2	3	3	2	1	**32**
Endangered *Conus* spp. species (3 species NT)	1	2	1	2	0	1	2	1	**20**
Relative weight of the criterion	***3***	***3***	***2***	***1***	***2***	***2***	***2***	***1***	

Table 5: Priority assessment framework for RNT terrestrial conservation targets, developed on the basis of the methodology presented in this Section.

Conservation Target	Global rarity and national	Local decline acquaintance	Value to processes Ecological	Responsiveness of indicators	Management conflicts Local	Economic value Direct (local)	Local Alternatives of management	Interest of the public	Total
Date palms (*Phoenix atlantica*)	3	2	3	1	0	1	2	2	**30**
Endangered plant species (excl. *Phoenix Atlantic)*	3	2	2	1	1	1	2	1	**29**
Poultry Marinas: Reedtail (*Phaethon aethereus*), Cory's Shearwater (*Calonectris edwardsii)*	2	2	2	2	1	1	1	2	**26**
Tarrafe (*Tamarix senegalensis*)	2	1	3	1	1	1	2	1	**25**
Left-handed* (*Neophron percnopterus*)	3	3	2	0	1	0	0	1	**25**
Ecosystems of flooded coastal lagoons and Associated migratory avifauna	2	1	3	1	1	0	2	1	**23**
Winch (*Pandion haliaetus*)	1	2	2	2	0	1	1	2	**21**
Landscape values	1	0	0	2	1	0	1	2	**11**
Species of birds	0	1	1	2	0	0	1	1	**10**
Relative weight of the criterion	***3***	***3***	***2***	***1***	***2***	***2***	***2***	***1***	

* - Technically extinct on the island

Table 6: Priority assessment framework for RNT marine conservation targets, developed on the basis of the methodology presented in this Section.

Conservation Target	Global rarity and national	Local decline acquaintance	Value to processes Ecological	Responsiveness of indicators	Management conflicts Local	Economic value Direct (local)	Local Alternatives of management	Interest of the public	Total
Elasmobranch community and its nurseries: Cat shark (*Ginglymostoma cirratum*), Bull shark (*Carcharhinus taurus*), Species of Hammerhead Shark, Tiger Shark (*Galeocerdo cuvier*), Manta Ray (*Mobula birostris*)	3	3	3	1	3	3	3	3	**46**
Whiting (*Mycteroperca fusca*) and other species of endangered demersal fish	3	1	3	2	3	3	3	3	**41**
Sea turtles (nesting)	3	0	3	0	3	3	3	3	**36**
Sea turtles (feeding)	3	2 (uncertain)	3	1	2	1	2	2	**34**
Buzio goat (*Persististrombus latus*)	0	3	2	2	3	3	2	1	**32**
Relative weight of the criterion	***3***	***3***	***2***	***1***	***2***	***2***	***2***	***1***	

On the basis of the final scores, the conservation targets were divided into three groups:

⇒ **Conservation targets of top priority for monitoring** (score equal to the highest of 31 points). These are conservation targets that have a medium high level of threat and many different interests around them. In principle, these are the conservation targets to address the resources available for monitoring in case their availability is extremely limited.
In the case of the PNN, for the terrestrial component, he highlighted as a priority level the stand of date palms (*Phoenix atlantica*), while for the marine component, the result of the analysis indicated that practically the entire set of conservation values identified and analysed has a very high level of priority, with particular emphasis on the populations of Elasmobranchs and demersal fish species.
For this evaluation class, the results of the analysis for the RNT were similar to those of the PNN, with the exception of a less evident level of priority for date palm stands, which is probably due to the lower comparative presence of this species in the RNT, and possibly to the lower pressures existing in the second context.

⇒ **Priority conservation targets for monitoring** (score between 16 and 30 points). These are conservation targets that have a medium high or intermediate level of threat and/or interests around them. In principle, these are conservation targets to address the resources available for monitoring when the larger follow-up needs of the highest priority targets are met.
For the terrestrial component of the PNN and the RNT, almost all identified conservation targets were evaluated in this class. For the marine component of the PNN, the group of species of the genus Conus was evaluated in this class .

⇒ **Non-priority conservation targets for monitoring** (score up to 15 points). These are conservation targets that have an intermediate or low level of threat and/or interests around them. In principle, these are conservation targets to address the resources available for monitoring when the larger follow-up needs of the priority targets are met.
For the terrestrial component of the PNN and the RNT, the only conservation target that was classified in this assessment class is the populations of estreparian bird species, while in the RNT the landscape values were also classified in this class, probably due to the absence of interests that at this stage aim at the transformation of the territory, compared to more active dynamics of transformation of the territory that characterize the PNN.

2.3 ANALYSIS OF DIRECT THREATS

The consultant did not develop this type of analysis, as he was not part of his ToR, and in order to be developed in a proper professional way, he needed to dedicate a few days to the in-depth study of the technical-scientific documentation at the island level (which was not even actually made available, see § 8.), and additionally to have two dedicated workshop days (one each AP), with the technical staff of the four Organizations involved in the BIOPAMA project. This kind of effort was not possible considering the program was already well "filled" with the needs for training on the monitoring methods to be introduced.
However, within the scope of the training, in order to lead the trainees to collectively deepen the themes related to the existing pressures on the natural resources of PAs, a group work was implemented, based on the threat assessment methodology provided by the *Open standards* prepared by the *Conservation Measures Partnership* (CMP, 2020).
Since it is not a work carried out by the consultant, the result of the group work (a group of trainees for each PA, as described in § 2.2) is not presented in this report, but it is possible to find the results in the respective projects of each PA created on the *Miradi Share web platform* (see § 5.).

Figure 6: Group work of the trainees to develop an assessment of the direct threats to conservation values.

3. TARGET MONITORING METHODS OF TRAINING

As indicated in § 1.2, the list in Annex 1 to the ToR of the consultancy incorporates the indication of a mixture of ecological monitoring targets and ideas for monitoring methods, to be measured by means of monitoring methods developed for that purpose.
The stages of technical exchange between the consultant and the project coordinator that led to the identification and improvement of the methods developed within the scope of the training are discussed in the sections of this chapter dedicated to each method.
The methods are presented in the chronological sequence in which their methodological sketches were delivered to the coordination team.

The monitoring target indicated in the ToR as "*6. Quantify shark catches, based on remains found and interviews with fishermen.*" was the subject of discussion, deepening of technical options, and finally evaluated from the point of view of timeliness.
The possibility of implementing a method, or part of it, using the leftovers of the fishing of individual sharks, was considered technically very difficult, considering as complicated to standardize the collection of data which, additionally, would be practically impossible to relate to the fishing effort. This possibility was therefore rejected.
The possibility of implementing a method, or part of it, based on fishermen surveys, on the other hand, was considered feasible, and potentially providing useful information. However, during the remote exchange between consultant and coordination team, the possibility emerged that another conservation organization working on the island of Boavista, Sphyrna, in recent times, implemented a study based on surveys of local fishermen. This possibility was successively confirmed during a meeting between the training group and a Sphyrna researcher, Jaquelino Varela. In addition, Jaquelino informed the staff present at the meeting that the data collection based on the survey of fishermen and related results was the subject of a scientific publication, which he committed to sharing with the consultant and the organizations involved in the BIOPAMA project (but until the day of delivery of this report, such publication had not been received by the consultant). With the project coordination team, it was agreed that the most appropriate framework for the development and implementation of such a method would be in collaboration with the NGO Sphyrna. On the basis of this, the assumptions for which the team should be developed and trained for the method indicated in point 6 were considered to have fallen. of Annex 1 to the ToR within the scope of this consultancy. This reduction in the load on training was beneficial for her, as it allowed her to dedicate 2 days of the training course to the reminiscent methods, which were already lacking the necessary days to train the team of trainees in their implementation.

Each selected monitoring method was developed following the contents indicated by the standard methodological sheet presented in Table 7.
The advanced drafts of each of the six methodological sheets presented in this chapter were delivered to the BIOPAMA project coordination team from a maximum of 60 to a minimum of 24 days in advance compared to the start of the on-site training. This was necessary to allow the coordination team to provide the appropriate feedback according to their perception of the context needs, as well as the appropriate development of the logistics necessary for the mission and field activities.

Table 7: Model of a descriptive form for marine/terrestrial ecological methods with references for its completion.

Method m onitoring	***Name of the monitoring method of the marine sub-component***
Method fro m monitoring	***Name of the monitoring method of the terrestrial sub-component***
Level	*Indicates the type of actor that implements the method, or the actor that provides the key data/information in the data collection process, according to the following scheme:* *Level 1 – Technical-institutional (Public Institutions, Universities and Institutes*

	research NGOs, technical conservation NGOs, etc.); *Level 2 – Private (companies, business representative organisations, tourism development companies, etc.)* *Level 3 – Civil society, and/or community actors (grassroots community associations, citizens, etc.)* *Level 4 – Students (EBI schools, Lyceums, etc.). This level can be integrated into Level 3 where the methods incorporating these two levels in the local context are limited in number.*
Target from monitoring	*It is the conservation value (or threat) of which the status/evolution is intended to be known through monitoring activities.*
Attributes key target from monitoring	*These are the characteristics you want to monitor to understand the quality of the status/evolution of the monitoring target.* *Each monitoring target can have one or more attributes.*
The reasons for choosing the monitoring target	*Why this monitoring target was chosen.*
The population, and/or the geographical scope that defines the target of monitoring.	*What is the threshold that defines the monitoring target (population, geographic, age, etc.)?* *What is the boundary that separates the target that is monitored from the same element, but which is in the rest of the universe?*
Protocol data collection	*Detailed methodological description (step-by-step) of all stages of data collection in the field.*
Indicators for each AP included in the monitoring	*The indicator is the quantitative measure we choose to assess the status/evolution of the key attribute. Each attribute can be measured by one or more indicators.* *Here are listed the indicators to be calculated, or supplied, for each AP.*
Aggregate indicators for the island	*Here are listed the indicators to be calculated, or supplied, in aggregate form for all PAs on the island, or the entire island if applicable.*
Indicators and additional data analytics	*Here we indicate all the indicators and analyses that are not expressed quantitatively, or at the level of an AP, or of an island (different territorial, population, temporal scopes, distribution maps, etc.).*
The reasons for the choice of the indicators	*Why these indicators were chosen, with a view to management choices.*
Place Of monitoring	*The exact places, or zones, where the method is implemented (coordinates of plots, transepts, geographical polygons, paths, coordinates of beach boundaries, markers fixed to the terrain, buoys, etc.). Attach maps in case it is necessary.*
Frequency and period from implementation	*In which years, in which months of the year, how many times a month, a week, a day, and in what part of the day should data collection be implemented?*
Coordination with other activities monitoring	*The activities that overlap with the activity on the card and the way they are related.*

Composition Of Team from monitoring	*Who is responsible for the collection and storage of all the data collected in the field (are there intermediate operators?), and how is the team composed for on-the-ground data collection (including sub-teams, if any)?*
Equipment of terrain	*Exhaustive list of all materials required for each field data collection sub-team.*
Registration Forms data in terrain	*How many and which field sheets are needed for systematized data collection?*

Data storage	*Where and how is the collected data stored?*
Needs from training	*What are the training activities required for a correct implementation of the monitoring method?*
Effort Working Capacity	*- how long it takes on average (in hours) to complete a data collection event from the moment the team leaves the field, until they return to the office, or at home.* *- The number of working hours required to implement a field data collection event (considering the sum of working hours of all team members).* *- the number of data collection events required to implement a monitoring year;* *- The number of working hours required to implement a monitoring year.*
Estimation material costs	*The expected costs for:* *- Permanent or long-term equipment (calculating the annual depreciation cost);* *- The implementation of all necessary events in a monitoring year; The cost of labor, purchase of means of transportation, and office/computer equipment is not calculated.*
Baseline	*(if data are available) The values of the indicators obtained from the monitoring activities implemented by the end of 2023 (data from each previous implementation year and average data).* *(if no data are available) Specify the period after which the baseline of this method will be available.*
Current threats on the monitoring target	*If the method is not targeted at measuring a threat, list here all threats identified as part of the development of the plan that have an impact on the monitoring target.*
Bibliography	*The documents used in defining the monitoring method, or reference for its implementation.*
Notes	*Any additional relevant information that does not fit with any of the previous sections.*

3.1 FISHERIES BIOLOGY OF THE WHELK (*PERSISTISTROMBUS LATUS*)

The method presented in this section is intended to comply with the following indication in Annex 1 of the ToR of the consultancy:
"*7. Quantify the extraction of búzio (mounds of discarded whelk shells). The intervention areas include: Baía das Gatas, Praia de Ervatão, Porto Ferreira and Derrubado.*"

On the basis of technical considerations, it was not complicated by the consultant to convince the coordination team of the BIOPAMA project, which was much more suitable to answer their management questions, to develop and implement a morphometric measurement method, associated with a method of measuring the effort and success of capture, compared to a method of measuring the heaps of whelk shells discarded at the landing sites.

The following sheet was prepared by Dario Cesarini, based on a method developed with Rui Freitas, Nivaldo Ramos and Sara Ratão, with inputs by Silvério Santos and Maria Medina Suarez for the context of the island of Boavista.

Method monitoring	**Fisheries biology of the Goat Whelk (*Persististrombus latus*)**

Level	1. Technical-institutional. 3. Civil society. Activity to be implemented in collaboration with the island's divers.

Method monitoring	**Fisheries biology of the Goat Whelk (*Persististrombus latus*)**
Target from monitoring	Pressure due to fishing activities on the whelk population (*Persististrombus latus*).
Key attributes of the monitoring target	i. Fishing effort; ii. Comparison of morphometry.
The reasons for choosing the monitoring target	i. The whelk is a highly sought-after natural resource in Boa Vista. Many local partners have a common fear that the level of exploitation has exceeded the limits to the long-term viability of their populations. There is a common opinion, first of all among fishermen, that these populations have had a clear decrease in their water source in recent decades. ii. The national stock of goat whelk shows signs of overexploitation, particularly on the islands of São Vicente, Santo Antão and on the islands most linked to tourism; iii. In the scope of the initial analysis implemented, scuba diving fishing was identified as the main threat to this species within the PNN and the RNT. iv. In the Fisheries Resources Management Plan 2019-2023, the implementation of a sampling system, as well as the carrying out of complementary socioeconomic studies on the fishery, was identified among the key actions for fisheries management. On the basis of this information, it was considered necessary and important to include in the monitoring system an activity that attempted to provide indications essential to promote the correct participatory management of fishing activities on this resource.
The population, and/or the geographical scope that defines the target of monitoring.	The pressure due to the fishing activities of local scuba diving fishermen on the whelk population located in the waters of the PNN and RNT.

Protocol data collection	Registration of boats engaged in whelk fishing Once a year, the monitoring team fills in the registration form of the boats that are dedicated to this fishing activity (Ficha_de_campo_e_Database_biologia_pesquera_buzio_cabra.xlsx). When in the regular monitoring activities, a dinghy not previously registered appears, the monitoring team fills in the specific form with the new dinghy registration. Boat and catch log on the day of monitoring At each monitoring event, after the faena has arrived at one of the landing sites (see section "Place of monitoring"), information is collected upon (Ficha_de_campo_e_Database_biologia_pesquera_buzio_cabra.xlsx): a. Number of vessels and divers who participated in the capture; b. Number of diving bottles used (normally divers consume the available bottles in full); c. Number of bags/nets of filled whelks per vessel; d. Number of individuals per bag/net sample (measure the number of individuals contained in two bags in each monitoring event); e. The fishing area used on the monitoring day. Registration of biometric data At each monitoring event, the field form is filled in (Ficha_de_campo_e_Database_biologia_pesquera_buzio_cabra.xlsx) with the

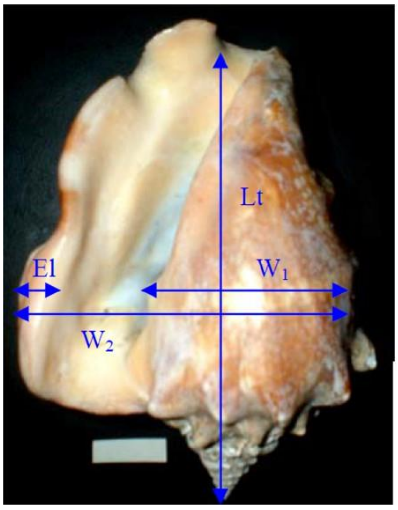
<table>
<tr><th>Method monitoring</th><th>Fisheries biology of the Goat Whelk (Persististrombus latus)</th></tr>
<tr><td></td><td>biometric data of the sampled individuals. Using a spike, the following biometric data are measured for 100 individuals in each sampling event (Figure 1):
i. gross weight (grams);
ii. individual's net weight (i.e. shellless) (grams);
iii. overall length (mm);
iv. lip thickness (mm);
v. overall width (W2) (mm);
vi. bottom turn width (W1) (mm).
Individuals (divided among the available bags) are selected at random (by the sampler or by asking the fisherman to do so) by inserting their hand into the bag, without eye contact. The maximum number of individuals measured for each bag is 20. It can be larger, only in the case where the bags of whelk fished are not in such a number as to allow the total of 100 individuals to be measured.


Figure 7: Location of morphometric measurements in a P . latus shell: total length (Lt), width 1 (W1), width 2 (W2) and lip thickness (El). Image extracted from Lopes & Monteiro (2005).</td></tr>
<tr><td>Indicators for each AP included in the monitoring</td><td>N/A</td></tr>
<tr><td>Aggregate indicators</td><td>The Annual Monitoring Report should include at least the following aggregated indicators for all sites included in this monitoring activity:
⇒ Total number of boats and divers engaged in this activity;
⇒ Average number of departures at sea per vessel per year;
⇒ Estimated total number of departures at sea of all vessels;
⇒ Average number of divers per vessel/day of departure;
⇒ Estimated total number of diving hours based on the number of bottles consumed averagely;
⇒ Estimate of the total number of whelk bags fished;
⇒ Estimation of the total weight of whelk fished;
⇒ Average number of whelk bags caught per bottle/diving time;
⇒ Average gross weight of whelk caught per bottle/diving time;
⇒ Average gross weight of the individuals captured;
⇒ Average net weight of captured individuals;
⇒ Mean total length of the individuals measured;</td></tr>
</table>

Method monitoring	Fisheries biology of the Goat Whelk (*Persististrombus latus*)
	⇒ Mean lip width of the individuals measured; ⇒ Mean total width of the individuals measured; ⇒ Mean internal width of the measured individuals; ⇒ Value of the ratio between the mean total length and the mean lip thickness of the individuals measured (this value being among all those indicated in this box the one that best indicates the stress due to fishing effort versus whelk age). The two sets of indicators listed above will also be provided in the database organized by: - Month of the year; - Fishing area (if this is not available alternatively, the landing site); - Boats. Where applicable, provide the average value of the last three years of monitoring for all the indicators listed above. Provide a graph of the temporal evolution over the years of the values of the indicators listed above, from the first to the last year of implementation of the monitoring activity, with the graphical indication of the moving average of the last three years of monitoring.
Indicators and additional data analysis	All the indicators listed above can be represented by maps, with data represented on the basis of fishing areas, or the provenance of fishermen/divers groups (i.e. landing areas). On an optional basis, the trends of the indicators in a horizon up to five years after the most recent year of monitoring.
The reasons for the choice of the indicators	All indicators are directly or indirectly related to the fishing effort on the resource and consequently to its level of exploitation. The mean values of length, total weight and width of the lips are related to the average age of the individuals fished. Tracking the evolution of these values provides indications on the change in the average age of the population and, indirectly, on the intensity of fishing pressures in this population, establishing a basis for Reference of the exploited resource.
Place Of monitoring	Diver disembarkation points at: - Baía das Gatas; - Ervatão Beach; - Porto Ferreira; - Knocked down.
Frequency and period implementation	In January of each year, the monitoring team registers the boats and divers engaged in this fishing activity by filling in the form (Ficha_de_campo_e_Database_biologia_pesquera_buzio_cabra.xlsx). The sampling and data taking effort for the catch and morphometric data is every year, 1 visit per week. The visiting time at the landing site is 15 minutes before the scheduled arrival time for the first fishing boat of the day at the landing site. This monitoring effort allows the morphometric measurement of about 5,200 individuals per year.
Coordination with other monitoring activities	The field team will take with them the Qfield software project for collecting data on human activities and other pressures, recording the events relevant to that monitoring method.
Composition Of	On the ground, the working group will consist of three operators: one

Method monitoring	Fisheries biology of the Goat Whelk (*Persististrombus latus*)
Team monitoring	Responsible for the daily activity, which also has the role of filling out the specific forms for collecting data in the field, two collaborators who are primarily concerned with the morphometric measurement of individuals. An activity manager who will have the role of coordinating and implementing the data collection at the selected sites, storing the collected data in the specific database for this monitoring activity and preparing monitoring outputs *(i.e. calculation of indicators)* on an annual basis.
Equipment of terrain	For fieldwork, it is necessary to: - 4x4 Car - 2 smartphones/tablets (one for use, one for backup), with charged bacteria, and the Excel software installed along with the data collection file specific to this monitoring - Artboards & Pens - A caliper for measuring the whelks for each operator in the field - Pocket scale - A power bank - A copy of the descriptive sheet of this method (i.e. this document)
Field data collection sheets	This activity requires three field data collection sheets (Ficha_de_campo_e_Database_biologia_pesquera_buzio.xlsx): 1. The registration form of the boats and divers that are dedicated to this fishing activity. 2. The record sheet of the results of the fishing days by boats. 3. The morphometric measurement form of the sampling of whelk-goat individuals.
Data storage	The sole coordinator for this monitoring activity, is concerned on a weekly basis with the transfer of the data collected in the database of the activity rented in the *OneDrive cloud*: (Ficha_de_campo_e_Database_biologia_pesquera_buzio.xlsx) In addition, the coordinator will synchronize the files changed during the field sessions with *QField Cloud*. When implementing the transfer, the sole coordinator for this monitoring activity and the person responsible for the daily activity of the last week, implement a quality control of the data collected, taking care to correct all possible errors or inconsistencies found. A back-up copy of the database will be stored on the reference NAS (alternatively on the hard disk or computer) for the storage of all data related to monitoring system.
Needs Training	The members of the monitoring team must attend the training to: - introduce them to the objectives, justifications and ways of implementing the method (2 hours of training class); - the correct measurement of biometric data, data collection and completion of forms (two afternoons of training in the field); - the management of the database and restitution of the indicators (2 hours of training class).
Effort Working Capacity	- An outing on the ground is considered to take, on average, 2 hours round trip and 3 hours at the disembarkation point to fill in the forms and measure the animals. Considering a team composed of two elements, it takes 15 hours of work to implement each monitoring event. Since 52 events are required per year, 780 hours of work are required to collect data in the field. - It is considered that 80 hours of work per year are required for the preparation and preparation of *monitoring outputs.* The total working hours required to obtain the monitoring *outputs* with this activity is estimated at around 860 hours/year (about

Method monitoring	Fisheries biology of the Goat Whelk (*Persististrombus latus*)
	of 108 days, or 22 weeks, or 5 man-working months/year).
Estimation material costs	The start-up costs for the activity can be summarized as follows: - 40,000 CVE for two smartphones/tablets (average life 4 years, 5% used for this activity); - 2,000 CVE for two calipers (average life of 4 years, used 100% for this activity); - 4,000 CVE for two pocket scales (average life of 6 years, used 100% for this activity); On this basis, long-life materials are considered to have an annual depreciation cost of around CVE 1,700/year. Considering each of the 40 field trips planned per year as a monitoring event, the average cost for each patrol would be summarized as follows: - 32,000 CVE of gasoline (considering on average 800 CVE/event); On this basis, it is considered that for the implementation of all data collection events in a monitoring year they require about 32,000 CVE. Finally, the sum of the amortization costs and current expenses required for one year of implementation of this monitoring activity amounts to a total of 33,700 CVE/year. No healthy staff the Considered here costs from the costs of the acquisition/operation of the car, and the costs of storing the data.
Baseline	The *baseline* for this monitoring activity will be defined after three years of implementation, and the assessment of the key indicators will be based on the moving average of the key indicators, based on three consecutive years of monitoring. However, the indicators achieved in the first and second year of implementation of the method provide a partial baseline indication for support management choices.
Threats current information about the target of monitoring	Intense fishing activity
Bibliography	Almeida, D. L. A. and Oliveira, M. I. 2005. *Contribution to the Characterization of the Stock of the Whelk* (*Strombus latus* GMELIN, 1791) *in the South Zone of the Island of São Vicente.* ISECMAR internship report, 45 pp. Mindelo, São Vicente. DNA and FMB, 2016. Monitoring Plan for the Complex of Protected Areas of Maio Island. Enhancement! of wellbeing and conservation in Cape Verde's biodiversity hotspots Project, UK/AID/FMB/DNA/FFI, Vila do Porto Inglês, Cape Verde. Mendes, L. R. C. 2002. *Characterization of the Fishing of Whelk* (*Strombus latus* Gmelin, 1791) *on the Island of São Vicente, Cape Verde*. Internship report, UALG, 58 pp. Faro, Algarve. Merino, S., Mendes, R., Monteiro, I., Almeida, A. 2007. *Contribution to the study of the Búzio Cabra fishery and its sustainable management*. VII Meeting of the Scientific Council of the INDP. Mindelo.
Notes	

Figure 8: Landing operations of whelk caught by divers.

Figure 9: Counting of bags and individuals of whelk per bag, by two trainees.

Figure 10: Group of trainees engaged in the morphometric measurement of whelk.

Figure 11: Morphometric measurement of the lip of the cowrie shell by one of the trainees.

3.2 CENSUS OF *ATLANTIC PHOENIX* AND *FICUS SYCOMORUS* STANDS AND RELATED HUMAN IMPACT RECORD

The method presented in this section is intended to comply with the following indication in Annex 1 of the ToR of the consultancy:
"2. To evaluate and map endemic vs invasive plant species e.g. Date palm (Phoenix Atlantica, ... and Fig tree (Ficus sycomorus ssp. gnaphalocarpa)."

The method described in this section was not immediately considered positively by the unanimity of the Organizations represented in the coordination team. The reasons for this are not completely clear to the consultant. Perhaps, the perception of the risk that this is a method that requires a data collection effort that goes beyond the possibilities of the partner organizations of the BIOPAMA project.

Based on the consultant's previous professional experiences (Cesarini, 2008a), as well as feedback from professionals on recent successful tree census experiences on other islands of the Archipelago (I. Duarte, *pers. com.*), the consultant is convinced that the method proposed here has a high probability of success also in the context of the island of Boavista, due to the following reasons:
- Among the monitoring methods introduced, it is the one whose implementation at a technical level is the easiest, either in the field or in terms of analysis and processing of collected data. This makes the method much more feasible for the organizations involved. Similar methods aimed at other tree species implemented on other islands in the country (e.g. São Nicolau in 2008 and 2022) have been successful by national technical teams of PAs and conservation NGOs.
- *Phoenix atlantica* is an internationally recognized priority conservation target that - from the perspective of international donors - makes it a target of greater interest compared to the other plant species present in Boavista. This issue is something that makes long-term monitoring activities on this natural resource more sustainable.
- it is the only monitoring method among those introduced, which can give "definitive" results (e.g. baseline), by sample areas (e.g. for the target PAs), already within 4 months of monitoring funded by the BIOPAMA project. This potentially puts the organizations involved in the possibility of showing donors concrete results of monitoring in the short term.
- the method can be implemented in "stages", according to the financial possibilities of the Organizations involved. The first stage would be the implementation of the census in the two PAs targeted by the BIOPAMA project (PNN and RNT). The second stage could be its extension to the other PAs on the island of Boavista; From this point of view, the stand of date palms in the Boa Esperança Nature Reserve is particularly important/priority. The third stage could be its extension to the entire territory of the island of Boavista.

Time and direct experience will show whether the rationale described above, applied by the consultant, was fixed or not.

For *Ficus sycomorus,* as the individuals belonging to this species are extremely rare on the island (at the moment 9 individuals have been censused, and it is considered unlikely that their total number on the island could exceed 20 individuals), it is suggested to implement a form of "active" census now. In other words, it is suggested that the monitoring team, through informal conversations with residents and local users, locate on a map and then move to ascertain the potential records, and implement data collection whenever the individual indicated by the community is effectively recognized as *Ficus sycomorus.*

The following sheet was prepared by Dario Cesarini, with inputs by Andrea Brusaferro.

Method monitoring	**Census of stands of *Phoenix atlantica* and *Ficus sycomorus* and record of related human impacts**
Level	1. Technical-institutional.
Target from monitoring	Stands of *Atlantic Phoenix* and *Ficus sycomorus* and evidence of human impacts on these stands.

Method m onitoring	**Census of stands of *Phoenix atlantica* and *Ficus sycomorus* and record of related human impacts**
Key attributes of the monitoring target	For each species: i. Size of the potentially breeding population; ii. Size of the population intended for the regeneration of stands (natural and artificial regeneration); iii. Frequency of occurrence of direct factors affecting the size of the population.
The reasons for choosing the monitoring target	i. *Phoenix* atlantica is a globally endangered species, classified by the IUCN Red List as *Endangered* (EM, criteria B1ab(iii)+2ab(iii)) since 2014. ii. *Ficus sycomorus* ssp. *gnaphalocarpa* is an endangered subspecies at the national level and on the island of Boa Vista, being classified as Critically Endangered in both geographical areas by the First Red List of Cape Verde (Gomes *et al.*, 1996). iii. *Ficus sycomorus* ssp. *gnaphalocarpa* is protected in Cape Verde by Regulatory Decree No. 7/2002 of 30 December. iv. *Phoenix atlantica* is potentially a *flagship species* (for the island of Boavista, in particular for the PNN and the RNBE.
The population, and/or the geographical scope that defines the target of monitoring.	All individuals of *Ficus sycomorus,* with a height equal to or greater than 1m, present on the island of Boavista. All Atlantic *Phoenix individuals*, of height equal to or greater than 1m that are within the PNN, or the RNT. According to the availability of human and financial resources, after the completion of the census of *Atlantic Phoenix* in the target area indicated above, the expansion of the census in two successive stages may be considered: 1. The settlements located in the reminiscent APs of the island. 2. The reminiscent settlements on the island, located outside the APs.
Protocol da ta collection	Each year of implementation of the activity, the field teams should comprehensively visit the entire target territory included in this monitoring activity. To ensure the census of all individuals of the target species, the teams in the field use photographic maps (e.g. satellites), which will be applied a grid of squares of 500m x 500m. Each time the area within a square of the grid will be fully viewed, and the complete census of the individuals of the target species present will be ensured, The square in question will be marked as "covered", and the team will move on to the next square of the grid to be enumerated. This function is ensured through the specific design of this method in the base of the *Qfield application*. If you have the availability to move more than one team in the field on the same day, it is necessary that the teams that work in the field clearly define among themselves, before starting the field work, which are the quadrants that each team will work on that day. This is to avoid the risk of the same individuals being enumerated twice. For all individuals belonging to the target species, with a height greater than 1 m, if: - identifies the species (for the specific recognition of the species included in the method, refer to the fact sheets in the Target Plant Species Recognition Sheets); - take the coordinates of their geographical position; - indicates whether it is a cluster (and in this case how many trunks), or a solitary trunk; - it measures the height of the plant (in the case of a cluster, only the tallest trunk is measured); - indicates the possible presence of new plants less than 1m tall around the individual (consider for this purpose the area included in a

Method monitoring	Census of stands of *Phoenix atlantica* and *Ficus sycomorus* and record of related human impacts
	circumference of radius of 5m around the census plan); - They record evidence of man-made damage and pressure, as well as physical and biological factors related to human activities. - records any other element deemed relevant by the monitoring team (e.g. suspected diseases, etc.). - Take one or more photos when there are doubts about any element of the monitoring (e.g. species assignment, actual presence of damage and pressure, suspected diseases, etc.). All of the above data is noted in the field file of this monitoring in the specific project database in the Qfield application. To reduce at least the likelihood of confounding in the specific recognition between *P. atlantica* and *P. dactylifera*, only individuals found in wilderness areas, or in areas where operators assess their presence as natural, will be included in the census pool. To facilitate this goal, *the following areas within the target APs* were digitized and incorporated into the specific design of the Qfield application: 1. Urbanized areas and vegetable gardens, within which individuals of palm trees are not enumerated; 2. A 600m buffer around urbanized areas and vegetable gardens, within which palm individuals are enumerated as probable *P. atlantica,* but distinct from the main pool of individuals considered as *P. atlântica* found at a distance of at least 600m from urbanized areas and vegetable gardens. In addition, all individuals who are found in or in the immediate vicinity of tourist facilities, or whose plantation is proven to be of anthropic origin, are excluded from the census. All individuals registered are individually included in the database Of Monitoring (Database_Censo_especies_arboreas_ameacadas.xlsx). All individuals surveyed are visited every two years, as part of the repetition of the monitoring activity, and on that occasion the parameters are updated Laid down By plug from field (Database_Censo_especies_arboreas_ameacadas.xlsx).
Indicators for each AP included in the monitoring	The Annual Monitoring Report shall include at least the following indicators for each species in each PA: ⇒ Total number of individuals over 1m in height surveyed. ⇒ Absolute and percentage difference between the current number of individuals and the number recorded in the last monitoring year ⇒ N° and % of individuals by height classes (classes to be defined for each species). ⇒ Average number of trunks in the cluster for species of this typology. ⇒ % of plants around them show evidence of regeneration (in the different classes). ⇒ Number and % of affected individuals for each type of human pressure/activity. Where applicable, provide the average value of the last three years of full monitoring for all indicators listed above. Provide a graph of the temporal evolution over the years of the average values of the indicators listed above, from the first to the last year of implementation of the monitoring activity, with the graphical indication of the moving average of the last three years of monitoring.
Aggregate indicators	The Annual Monitoring Report shall include the following aggregate indicators for the PAs included in the monitoring system: ⇒ Total number of individuals over 1m in height surveyed.

Method monitoring	**Census of stands of *Phoenix atlantica* and *Ficus sycomorus* and record of related human impacts**
	⇒ Absolute and percentage difference between the current number of individuals and the number registered in the previous year. ⇒ Number of individuals per height class (classes to be defined for each species). ⇒ Average number of trunks in the cluster for species of this typology. ⇒ % of plants around them show evidence of regeneration. ⇒ Number of affected individuals for each type of human pressure/activity. Where applicable, provide the average value of the last three years of full monitoring for all indicators listed above. Provide a graph of the temporal evolution over the years of the average values of the indicators listed above, from the first to the last year of implementation of the monitoring activity, with the graphical indication of the moving average of the last three years of monitoring.
Indicators and additional data analysis	The Annual Monitoring Report shall also include for the PAs included in the monitoring system: - A distribution map of all censused individuals for each species. - A distribution map of all censused individuals for each species belonging to the lowest height class. - A distribution map of all individuals that show evidence of regeneration around them. - A distribution map of individuals affected by the most common and/or most conservation-relevant human pressures/activities. - The number of individuals classified as probable *P. atlantica* (i.e. included within the 600m buffer around urbanized areas and vegetable gardens) and its % change compared to the previous monitoring event. - % of individuals already present in the monitoring of the previous period. - % of individuals in the population who have disappeared or died. - % of the current population as a result of reforestation activity in the last period. - % of the current population made up of new individuals registered as a result of natural reproduction. - the indication of the most important areas of occurrence in terms of conservation of each species in the territory. - The average number of trunks per cluster for the species characterized for this vegetation typology. On an optional basis, the trends of the indicators in a horizon to 2030.
The reasons for the choice of the indicators	In the case of populations of arboreal species, a population census was considered feasible, and the indicators associated with this type of monitoring activity are the most accurate to know the conservation status of these species on the island.
Place Of monitoring	The entire territory of the APs included in the monitoring system.
Frequency and period implementation	This monitoring activity is implemented every other year, i.e. every two years. In the years of implementation, the implementation period will be defined according to the needs of the implementing organizations, but in the form of being implemented and completed in the months between January and July.

Coordination with other monitoring activities	The field team will take with them the Qfield software project for collecting data on human activities and other pressures, recording the events relevant to that monitoring method.

Method monitoring	**Census of stands of *Phoenix atlantica* and *Ficus sycomorus* and record of related human impacts**
Composition Of Team monitoring	In the field, the working group will be composed of two operators: a person responsible for the daily activity, who also has the role of filling out the specific form for collecting data in the field, and a collaborator. An activity manager who will have the role of coordinating and implementing the data collection at the selected sites, storing the collected data in the specific database for this monitoring activity and preparing monitoring outputs *(i.e. calculation of indicators)* on an annual basis.
Equipment of terrain	For fieldwork, it is necessary to: - A 4x4 vehicle - 2 smartphones/tablets (one for use, one for backup), with charged bacteria, and the Qfield software installed together with the specific project of this monitoring - Electronic Pocket Distance Meter (EDMs; 0-50m, not less than 30m) - A tape measure of at least 30m - Sticks of a length equivalent to the length of the arm of the team members - 1 camera (can be the one on the smartphone) - 1 binocular - A copy of the descriptive sheet of this method (i.e. this document) - Field Clothing - Artboards & Pens - First aid kit For data analysis in the office, you need a computer with Excel, Qgis and any browser installed.
Field data collection sheets	There is a specific field sheet for this monitoring activity built into a *Qfield project*.
Data storage	The sole coordinator for this monitoring activity, is concerned on a weekly basis with the transfer of the collected data in the database of the activity rented in the *OneDrive cloud:* (Database_Censo_especies_arboreas_ameacadas.xlsx). In addition, the coordinator will synchronize the files changed during the field sessions with *QField Cloud*. Before implementing the transfer, the sole coordinator for this monitoring activity and the daily responsible for the activity in the last week, implement a quality control of the data collected during that day, taking care to correct any possible errors or inconsistencies found. A back-up copy of the database will be stored on the reference NAS (alternatively on the hard disk or computer) for the storage of all data related to monitoring system.
Needs Training	Initial training, implemented by the author of this descriptive sheet, is required on: - Introduction to the method (2h). - Recognition of the target species (1h). - Two one-day field trips to test the method and define the most correct way to fill in the field sheets, training the teams for its implementation. - The transfer of data in the database (1h). Next, a day of discussion and training is necessary to take place on an annual basis, to adjust any errors in data collection and ensure homogeneity in the application of the method among all Organizations Involved. This periodic training day shall include at least half a day

Method monitoring	**Census of stands of *Phoenix atlantica* and *Ficus sycomorus* and record of related human impacts**
	field trip.
Effort Working Capacity	- For the data collection component, it is considered necessary to have 48 trips by a team in the field, each one of an average of 8 hours (6 h of data recording, plus 2 h of round trip from Sal Rei, preparation and other tasks). Considering two members of the team, it means a total of 768 h/year. - In addition, 80 hours of work per year are considered necessary for the preparation and preparation of monitoring outputs. The total number of working hours required to obtain the monitoring outputs with this activity is estimated at around 848 hours in each year of implementation (about 106 days, or 21 weeks, or 4.5 man-working months/year). This box of the form will have to be reviewed immediately after the first year of implementation of the activity, to ensure its coherence with the reality found on the ground (i.e. effective time ascertained for the implementation of the activity). The estimate provided refers to the implementation of the activity in the two target APs.
Estimate material costs	The start-up costs for the activity can be summarized as follows: - 40,000 CVE for two smartphones (average life of 5 years, used 20% for this activity); - 20,000 CVE for a pair of binoculars (average life 10 years, 10% used for this activity); - 3,000 CVE for two tape measures (average life of 5 years, 50% used for this activity); - 5,000 CVE for an electronic pocket distance meter (average life of 5 years, used 30% for this activity). On this basis, long-life materials are considered to have an annual depreciation cost of around CVE 2,400/year. For annual implementation costs, this monitoring activity requires: - 48,000 CVE of petrol for the 48 trips in the field. This cost can be significantly reduced if two monitoring teams are taken to the field instead of one with the same displacement in the field. Finally, the sum of the depreciation costs and current expenses required for one year of implementation of this monitoring activity will be taken into account in the total in ca. of 50,400 CVE/year. Personnel costs, car acquisition/operating costs, and data storage costs are not taken into account here.
Baseline	The *baseline* for the indicators will be available at the end of the first year of monitoring.
Current threats on the monitoring target	⇒ Ecological competition for introduced and invasive species, particularly for *Prosopis juliflora,* due to the competitiveness of invasive species stands in the occupation of space and subtraction of limited available water resources. ⇒ Free grazing.
Bibliography	Cesarini D., 2008. *Monitoring Plan – Monte Gordo Natural Park*. Integrated and Participatory Management of Ecosystems in Protected and Surrounding Areas (Phase I), MAA/GEF/UNDP, Praia, Cape Verde, 186pp. Elzinga C. L., Salzer D.J. & Willoughby W. 1998. *Measuring and monitoring plant populations.* U.S. Department of the Interior - Bureau of Land Management, pp.492.

Method monitoring	**Census of stands of *Phoenix atlantica* and *Ficus sycomorus* and record of related human impacts**
Notes	Some approximation in data collection may be caused by the inaccessibility of some areas of study. The measures included in the methodological protocol should reduce to a minimum the possibility of classifying individuals of *P. dactylifera,* or hybrids between *P. dactylifera* and *P. atlantica,* as *P. atlantica.* Considering the aforementioned methodological measures adopted, it is probable that the indicators provided with this method represent an underestimation of the actual population of *P. atlantica* in the target sites. Based on this consideration, the information and knowledge provided with this activity is of great value to the decision-making processes in the management of the target PAs and the resources associated biologics.


Figure 12: Height measurement of a *P. atlantica individual* with the proportion technique of Talete's theorem.

3.3 RECORDING DATA ON THREATS AND HUMAN ACTIVITIES

The method presented in this section aims to meet the following indications in Annex 1 of the ToR of the consultancy:
"4. To evaluate the abundance and distribution of free grazing cattle in PAs."
and
"*5. Evaluate the circulation of veichles on the beaches, dunes and inside the PAs, quantifying the number of vehicles and people."*

Considering the lack of quantitative data on the pressures indicated in the ToR, as well as for the other pressures and human activities in the PAs, the method proposed by the consultant is based on a

Quite a "classical" approach to this area. With the proposed approach, it is intended to achieve the most comprehensive overview possible of most of the pressures occurring in the target PAs.
The consultant believes that with the information obtained in 1 to 3 years of implementation of the proposed method, the actors involved in the management of the target PAs will certainly have evidence with which to make informed decisions for the management of these sites.
In the same period of implementation, the evidence provided by this method, even when it will not be sufficient to make informed decisions about management measures to be adopted, will allow the efficient definition of more specific methods, aimed at one or a few target pressures, which will finally allow obtaining the key information necessary for management, but with limited costs in technical and financial terms. compared to a situation of lack of basic knowledge.

At the explicit request of the BIOPAMA project coordination team, the method does not include any human activity or pressure that is directly related to the marine component of the target PAs. This includes the pressures that are developed from the terrestrial environment.

The registration of exotic plant species has not been included in this method, and a specific method has already been developed for the measurement of this pressure.

The registration of beach litter that arrives from the sea was not incorporated into the method presented here because, by its nature, it does not lend itself to being effectively measured through this type of method. To measure this type of pressure, it is necessary to develop a specific method that can be technical (Cesarini & Bernasconi, 2010), or participatory (DNA and FMB, 2016).

The following sheet was prepared by Dario Cesarini.

Method monitoring	**Recording data on threats and human activities**
Level	1. Technical-institutional. Potentially, the field fiche can be used, or filled in, or on the basis of information provided by institutional actors, or by other sectors (businesses, citizens, civil society, etc.), if the source of information is considered reliable, but is usually completed by the staff of the organizations "internal" to the monitoring system.
Target from monitoring	The set of human activities and causes of pressures of origin completely, or partially, dependent on humans, which impact on the natural resources that reside, or use in at least part of their biological cycle, the PAs targeted for monitoring.
Key attributes of the monitoring target	The occurrence and/or the intensity Of following activities/threats/pressures/alarm signals: - Animals found dead; - Clearing of natural vegetation; - Circulation of vehicles on beaches and in other prohibited areas; - Potentially invasive alien species; - Extraction of sand and other aggregates; - New constructions; - Free grazing; - Pollution; - Catchers, or suspected catchers of turtles and nests; - Presence of tourists and visitors; - All other elements not mentioned above, but which fit with the definition of the "Monitoring target" section.
The reasons for choosing the monitoring target	i. Knowledge of the evolution of known and potential threats/pressures is essential to advance hypotheses about their relationship with the evolution in the state of conservation targets. Some threats/pressures are extremely difficult to measure directly, others require specific monitoring methods that

Method monitoring	Recording data on threats and human activities
	can have significant costs. This monitoring method is intended to be a low-cost/effortless data collection solution to gain knowledge in the scope described. ii. To allow through this method the systematic collection and processing of data on the registration of occasional and/or sporadic events, which would otherwise be lost. iii. The simplicity of the methodology adapts to its use for educational purposes (e.g. activities in schools).
The population, and/or the geographical scope that defines the target of monitoring.	See the description of "Monitoring target".
Protocol data collection	By traversing the free transect, the monitoring team looks for records of activity/threats/pressures/alarm signals. Whenever the team in the field finds a target element for monitoring, it must fill in a registration form of the specific *Qfield* project installed on the smartphone/tablet, indicating all the necessary values according to the typology of the target element that was found (see the registration keys in the specific *Qfield project*). The records will be associated with their geographic coordinates, while the unit of measurement of the density of the records is the time spent in the field by the monitoring team, implementing the free transects. In addition, each time a technician from the partner organisations travels in the field, he/she should take with him and fill in, as far as possible, the data collection form related to this monitoring activity, whenever he finds an event relevant to this monitoring activity. This type of registration is particularly recommended for mobile events, and more generally those that take place live during the field trip. This type of record is limited to the following types of records: - Dogs and cats loose outside the 1km buffer of urban areas and vegetable gardens; - Dead animals of conservation interest, dogs, cats and other species considered to be of particular relevance, or as extraordinary records; - Hunters and hunted animals; - Larger clearances; - Inert extractions to occur at the time of registration; - Fires to occur, or have occurred; - New constructions and other works to take place outside the 1km buffer of urban areas and vegetable gardens; - Extraordinary pollution events; - Another type of record not listed above, but of extraordinary character and severity of the actual and potential impact. These additional data will be available to the organisations concerned and may be reproduced in the maps and other similar communication tools, but may not contribute to the calculation of the indicators of this monitoring, and its collection does not occur in a standardized way.

Indicators for each AP included in the monitoring	The Annual Monitoring Report shall include at least the following indicators for each PA: ⇒ Total area of natural vegetation that has been cleared. ⇒ Total number and densities of recorded individuals belonging to exotic animal species (cats, dogs, *Numida meleagris,* etc.) found outside

Method monitoring	Recording data on threats and human activities
	of a radius of 1 km from the outer perimeter of the villages. ⇒ Total number and densities of recorded individuals belonging to animal species considered invasive (e.g. *Corvus ruficollis*). ⇒ Number and densities of trucks for transporting aggregates found. ⇒ Number of new constructions outside the consolidated perimeters. ⇒ Number and densities of visitors and workers found, classified by type of activity (leisurely walking, type of work, use of the beach for recreation, etc.). ⇒ number and densities of cars, or other motorized means, that pass outside the roads and settlements. ⇒ No. and densities of free-range cattle found (of all non-domestic predator species). ⇒ Number of sites with solid waste accumulation (excluding the measurement of coastal litter which does not lend itself to being measured using this type of methodology). ⇒ Number and type of specific pollution records (chemical pollution, organic pollution, etc.). ⇒ Number and type of records of animals found dead. View the up-to-date and complete list of indicators in the specific Excel database towards this activity from monitoring: Fichas_de_campo_e_base_de_dados_registo_ameacas_e_atividades_humana s.xlsx When applicable, provide the average value of the last three years of all the indicators previously listed. Provide a graph of the temporal evolution over the years of the values of the indicators listed above, from the first to the last year of implementation of the monitoring activity, with the graphic indication of the Moving average of the last five years of monitoring.
Aggregate indicators	The Annual Monitoring Report shall include at least the following aggregated indicators for the PAs included in the monitoring system: ⇒ Total area of natural vegetation that has been cleared. ⇒ Total number and densities of recorded individuals belonging to exotic animal species (cats, dogs, *Numida meleagris,* etc.) found outside a radius of 1 km from the outer perimeter of the villages. ⇒ Total number and densities of recorded individuals belonging to animal species considered invasive (e.g. *Corvus ruficollis*). ⇒ Number and densities of trucks for transporting aggregates found. ⇒ Number of new constructions outside the consolidated perimeters. ⇒ Number and densities of visitors and workers found, classified by type of activity (leisurely walking, type of work, use of the beach for recreation, etc.). ⇒ number and densities of cars, or other motorized means, that pass outside the roads and settlements. ⇒ No. and densities of free-range cattle found (of all non-domestic predator species). ⇒ Number of sites with solid waste accumulation (excluding the measurement of coastal litter which does not lend itself to being measured using this type of methodology). ⇒ Number and type of specific pollution records (chemical pollution, organic pollution, etc.). ⇒ Number and type of records of animals found dead. View the up-to-date and complete list of indicators in the specific Excel database towards this activity from monitoring: Fichas_de_campo_e_base_de_dados_registo_ameacas_e_atividades_humana

Method m onitoring	Recording data on threats and human activities
	s.xlsx When applicable, provide the average value of the last three years of all the indicators previously listed. Provide a graph of the temporal evolution over the years of the values of the indicators listed above, from the first to the last year of implementation of the monitoring activity, with the graphic indication of the moving average of the last three years of monitoring.
Indicators a nd additional data analysis	The Annual Monitoring Report may include, depending on the relevance of the information, the following maps of the distribution of records of: ⇒ Sites where natural vegetation has been cleared. ⇒ Exotic animal species (cats, dogs, *Numida meleagris,* etc.). ⇒ Animal species considered invasive (e.g. *Corvus ruficollis*). ⇒ Trucks for the extraction and transport of aggregates. ⇒ New construction outside the consolidated perimeters. ⇒ Visitors found, sorted by activity type. ⇒ Cars, or other motorized means, that pass outside the paved roads of the settlements. ⇒ Loose cattle classified by species. ⇒ Sites that have solid waste accumulation. ⇒ Specific pollutions. ⇒ Terrestrial animals found dead. View the up-to-date and complete list of indicators in the specific Excel database towards this activity from monitoring: Fichas_de_campo_e_base_de_dados_registo_ameacas_e_atividades_humana s.xlsx On an optional basis, the trends of the indicators in a horizon to 2030.
The reasons for the choice of the indicators	It is a selection of intensity indicators measurable through the systematic collection of observations. Through this method it is possible to have relevant information on the evolution of the pressures/threats measured.
Protocol se curity	Safety Materials: - Hat - Sunscreen - Water - A first aid kit - Mobile phone with charge and credit Safety instructions: - The field team must consist of at least two elements. - Always have water in order to avoid dehydration; - Avoid dangerous routes without straying too far from the chosen itinerary. - Ensure that all the equipment necessary for the execution of the monitoring as well as the safety equipment is in a usable condition (batteries, chargers, binoculars, communications, expiry of medications, etc.) - Safeguarding personal and material physical integrity. - Never enter into conflict or discussions with other elements, as well as with strangers who come across during monitoring (in case of flagrante in illegal activities within the PAs, try to collect photos and report them to DMAA, which in turn will contact the competent authorities). - In the event of an accident, provide necessary and possible first aid, contact the person of reference for the Organization, transmit the situation and wait for superior directives. - Always avoid using the medications randomly, if not

Method m onitoring	**Recording data on threats and human activities**
	Know the effects or counter-effects, read the instructions or otherwise do not use them (contact competent authorities for these situations). - In case of very heavy rain that prevents the continuity of monitoring, seek shelter and contact the reference organization if there is difficulty in returning to the starting point or safe point. - Report any damage or malfunction to the equipment, in order to Be able to solve or request new ones, in a timely manner for future monitoring.
Place Of monitoring	Free transects within the target PAs, concerned in the medium and long term with providing coverage to the entire territory of the PAs, at different times of the year and the day. In addition, on an occasional basis, wherever other activities are implemented on the ground.
Frequency a nd period im plementation	Every year, every month, twice a month, a free transect of 6 hours, in each AP. A total of 48 transects per year are planned. In addition, when records occur, whenever other activities are implemented in the field.
Coordination with other monitoring activities	Potentially, many monitoring activities can be associated with this activity. The cases in which this association is more opportune are pointed out within this section of the descriptive sheets of the activities in question. question.
Composition Of Team m onitoring	In the field, the working group will be composed of two operators: a person responsible for the daily activity, who also has the role of filling out the specific form for collecting data in the field, and a collaborator. A car driver will be able to take the staff to the starting point of the transect and pick them up six hours later at the place scheduled for the end of the transect. A single activity manager will have the role of coordinating and implementing the data collection at the selected sites, storing the collected data in the specific database for this monitoring activity and preparing monitoring outputs *(i.e. calculation of indicators)* on an annual basis.
Equipment of terrain	The field equipment consists of: - Car - 2 smartphones/tablets (one for use, one for backup), with charged bacteria, and the *Qfield* software installed together with the specific project of this monitoring - A copy of the descriptive sheet of this method (i.e. this document) - Electronic pocket distance meter (EDMs; 0-50m, not less than 30m), alternatively a field rangefinder, or a tape measure of at least 30m - Field Clothing - Artboards & Pens - Field Notebook - Reusable plastic bags for collecting plants, or other samples - Adhesive Paper Labels for Plastic Bags - AP Map - Two binoculars - Photo camera (can be the one from the smartphone) For data analysis in the office, it is necessary to: - A computer with Excel and Qgis software installed, as well as any browser browser.

Registration Forms data in	This activity requires two data collection sheets, one in Excel base, to the data from transept

Method monitoring	**Recording data on threats and human activities**
terrain	(Fichas de campo e base de dados registo ameacas e atividades humanas.xlsx) and a Qfield-based database for log data.
Data storage	The sole coordinator for this monitoring activity, is concerned on a weekly basis with the transfer of the collected data in the database of the activity located in the *OneDrive cloud:* (Fichas de campo e base de dados registo ameacas e atividades humanas.xlsx) In addition, the coordinator will synchronize the files changed during the field sessions with *QField Cloud*. Before implementing the transfer, the sole coordinator for this monitoring activity and the daily responsible for the activity in the last week, implement a quality control of the data collected during that day, taking care to correct any possible errors or inconsistencies found. The same operation is implemented after the analysis of the photographic documentation. A back-up copy of the database will be stored on the reference NAS (alternatively on the hard disk or computer) for the storage of all data related to the monitoring system.
Needs Training	Initial training, implemented by the author of this descriptive sheet, is required on: - The structure of the field file, but above all on the activities/events and typologies targeted for monitoring, with specific input from the good context (e.g.: which are the potentially invasive exotic or autochthonous animal species, how to measure the area affected by a type of pollution, etc.) (4h); - Two field trips of at least half a day, to test and train on data collection in the field and define the most correct way to fill out the data collection forms. Next, a day of discussion and training is necessary to take place on an annual basis, to adjust any errors in data collection and ensure homogeneity in the application of the method among all Organizations Involved. This day should include a field trip day.
Effort Working Capacity	- For the data collection component with dedicated transects, 48 field trips are considered, each one averaging 8 h (6 h transect, plus 2 h round trip from Sal Rei, preparation and other tasks). Considering two members of the team, it means a total of 768 h/year. - The working time required for the implementation of this activity throughout the other monitoring and routine activities is considered to be included in the implementation time of these activities. - In addition, 80 hours of work per year are considered necessary for the elaboration and preparation of monitoring outputs. The total working hours required to obtain the monitoring outputs with this activity is estimated at around 848 hours/year (about 106 days, or 21 weeks, or 4.5 man-working months/year).
Estimation material costs	The start-up costs for the activity can be summarized as follows: - 40,000 CVE for two smartphones (average life 4 years, used 5% for this activity); - 40,000 CVE for two binoculars (average life 10 years, 10% used for this activity); On this basis, long-lasting materials are considered to have an annual depreciation cost of around CVE 900/year. For the annual implementation costs of this monitoring activity

Method monitoring	Recording data on threats and human activities
	Requires: - 40,000 CVE of petrol for the 48 trips in the field. - 4,000 CVE for sample collection material. On this basis, it is considered that for the implementation of all data collection events in a monitoring year they require about 44,000 CVE. Finally, the sum of the depreciation costs and current expenses required for one year of implementation of this monitoring activity will be taken into account in the total in ca. of 45,000 CVE/year. No healthy staff the Considered here costs from the costs of the acquisition/operation of the car, and the costs of storing the data.
Baseline	The baseline for the indicators will be available after three full years of implementation of this monitoring activity.
Threats Current About the monitoring target	N/A
Bibliography	Cesarini D. and Bernasconi L., 2010. *Terrestrial Ecosystem Monitoring – North Province*. Final Report. EPA/MEMP/IDA, Malé, Republic of the Maldives, 392 pp. DNA and FMB, 2016. Monitoring Plan for the Complex of Protected Areas of Maio Island. Enhancement! of wellbeing and conservation in Cape Verde's biodiversity hotspots Project, UK/AID/FMB/DNA/FFI, Vila do Porto English, Cape Verde.
Notes	

Figure 23: The trainer with a group of trainees recording solid pollutants, during the testing/training of the method of recording data on human threats and activities.

3.4 COLLECTING ATMOSPHERIC CLIMATE DATA IN COMMUNITIES

The method presented in this section aims to meet the following indications in Annex 1 of the ToR of the consultancy:
"3. Monitor precipitation."
and
"*8. Identify indicators of long-term climate change. (For example: sea air temperature, sand, pH of the sea/salt pans, etc.).*"

In Boavista there is an international airport that must necessarily have its own climate data, which could be achieved through a partnership with the managing authority.
International actors collect data on oceanographic parameters of Cape Verdean waters with equipment from high potential technician since Dozens from years (https://www.st.nmfs.noaa.gov/copepod/time-series/de-30301/; https://earthobservatory.nasa.gov/global-maps/MYD28M/AMSRE_SSTAn_M). The series of data collected by these actors show that there is a clear increase in average temperatures and anomalous sequences from the late 1980s and early 1990s.
The consultant questioned how useful it would be for the management of the Boavista PAs, to know after 10/20 years from now, that the temperature of the waters of the Ocean, or of the atmosphere, increases, when we have teams of scientists who tell us that in Cape Verdean waters this has been happening for about thirty-five years...
In general, the consultant suggested to the coordination team of the BIOPAMA project to give up this type of monitoring, or at least, to move from a technical implementation approach to a participatory monitoring approach, thus acquiring this activity an added value that would justify its implementation much better.

In order to define the methodological choices, it was necessary, first of all, to explain the budget available for the equipment intended for the collection of climate data.
At that stage (December 2023), the budget available for the purchase of new usable materials for all monitoring activities included in this initiative was indicated to be around €2,400 (K. Yeoman, *pers. com*.).
Considering that the Organizations involved already had most of the equipment necessary for the implementation of the planned activities, and assuming that around 50% of the remaining budget at that stage could be dedicated to the implementation of this monitoring method, the amount still available automatically excluded:
- All methods based on the use of modern multifunctional data collection units that allow the collection of different types of atmospheric climate data.
- all methods based on the use of equipment such as *combo data loggers* , which usually measure attributes of marine environments such as: dissolved oxygen, pH, temperature, salinity/conductivity.
- the overwhelming majority of methods based on the use of a mix of equipment that measures water temperature and luminosity, and/or temperature and pH, and/or measurement of water turbidity with the Secchi disk, and/or temperature and salinity (the consultant provided concrete equipment options available on the market for each of the possibilities listed), This possibility was excluded either because of the costs of implementing the activities at sea, or because of the costs of materials that exceeded the budget in the different hypotheses.

At this point, the consultant suggested opting for the adoption of a small group of measurement points for atmospheric variables managed by the communities (EBI schools, women in the villages, people with physical handicaps, etc.), with the costs for the acquisition of the equipment and implementation of the proposed method being feasible according to the available budget.
In case of success with the implementation of this method, the implementation of a method of collecting basic marine parameters with fishermen (temperature, turbidity) could be thought of in parallel, when an appropriate budget will be available.
In the context of these methods, the quality of the data, although useful, becomes secondary in comparison to the role of awareness and community engagement in these themes.

The following sheet was prepared by Dario Cesarini.

Method m onitoring	**Collecting atmospheric climate data in communities**
Level	3. Civil society. Activity to be implemented in collaboration with community operators.
Target fro m monitoring	Atmospheric climatic parameters and their long-term evolution
Key Target Attributes fr om monitoring	The target atmospheric parameters of this monitoring method are: - Air temperature; - Relative humidity; - Rainfall.
The reasons for choosing the monitoring target	Climate change is a global phenomenon that has a local impact on ecosystems and the communities that are part of them. According to the partners involved in the implementation of the monitoring system, there is no availability of atmospheric climate data at the local level. In addition, this method offers opportunities to raise awareness among the communities of Boavista on the subject of climate change through their direct engagement in measuring these changes.
The population, and/or the scope geographic that defines the monitoring target.	The island of Boavista.
Protocol da ta collection	At each data collection site, the person responsible for this activity records daily To 8:00 from morning In Chips from collection (Ficha de campo e Database Coleta parametros climaticos comunitaria.xl sx), the following data: - Maximum temperature of the last 24 hours (°C); - Minimum temperature of the last 24 hours (°C); - Maximum relative humidity of the last 24 hours (%); - Minimum relative humidity in the last 24 hours (%); - Precipitation lasts for 24 hours (mm). Details of the position and use of the equipment shall be provided as part of the specific training.
Indicators for each AP included in the monitoring	N/A

Aggregate indicators for the island	The Annual Monitoring Report for each data collection site shall include at least the following indicators: ⇒ Average annual maximum temperature; ⇒ Average maximum temperature in each month; ⇒ Average annual temperature; ⇒ Average temperature in each month; ⇒ Average annual minimum temperature; ⇒ Average minimum temperature in each month; ⇒ Average annual maximum humidity; ⇒ Average maximum humidity in each month; ⇒ Average annual minimum humidity; ⇒ Average minimum humidity in each month; ⇒ Total annual rainfall; ⇒ Total rainfall in each month; ⇒ The average values of the indicators listed from all aggregated data collection sites. Provide a graph of the temporal evolution over the years of the values of the

Method monitoring	Collecting atmospheric climate data in communities
	Indicators listed above from all aggregated data collection sites, from the first to the last year of implementation of the monitoring activity, with the graphical indication of the moving average of the last five years of monitoring.
Indicators and additional data analytics	The Annual Monitoring Report may provide, for each of the five parameters measured, a map of Boavista Island, indicating the annual average values recorded at each data collection site according to its geographical position.
The Reasons Of choice of the indicators	Temperature is the most important atmospheric climate parameter with which to measure climate change on a global and local scale. As Cape Verde and Boavista are located in the latitude of the Sahel, and this region is one of the most impacted worldwide by the effects of climate change, the knowledge of the long-term evolution of this parameter becomes of great interest for this geographical context. Precipitation is another very relevant parameter in the measurement of climate change, and its evolution in the long term is influenced by regional and local factors, even more than global. Since water availability at the level of natural ecosystems is strongly related to precipitation, its long-term changes can certainly cause changes in terms of ecosystem structures and dynamics. In addition, but not secondarily, rainfall influences many local economic activities, especially in rural areas (agriculture, breeding, etc.); It has always been a central theme in the quality of life of Cape Verdeans, and an element of great interest. Relative humidity is also a climatic parameter influenced by the climate change, which in turn can alter the conditions of ecosystems.
Place Of monitoring	Data collection will take place in five sites, corresponding to five villages: - Bakery - Cabeço dos Tarrafes/Fundo de Figueiras/João Galego - Old Village - Rabil - King Salt
Frequency and period implementation	Data is collected once a day at each site, every day of the year. Every three months, the activity coordinator visits each site to collect data from the last three months of monitoring. Other forms of collection of completed forms are possible according to individual agreements with each data collector.
Coordination with other monitoring activities	No

Composition Of Team from monitoring	One resident of the community in each of the five villages indicated. Priority should be given to the selection and/or involvement of people with physical handicaps, female heads of households, or other fragile categories. An activity coordinator will have the role of collecting the data collection sheets on a quarterly basis and transferring them into the monitoring system's database. Once a year, it will also have the role of compiling the data for the calculation of the indicators and the return of the information obtained from this activity.
Equipment from	For data collection at each monitoring site:

Method m onitoring	**Collecting atmospheric climate data in communities**
terrain	- A digital thermometer-hygrometer, with a resolution of 0.1 °C, with a sensor separate from the display, and a function of recording maximum and minimum temperature and relative humidity. - An analog rain gauge, possibly with a movable support. - Monthly paper data collection sheets and writing materials.
Field data collection sheets	This activity requires a single field data collection sheet: Ficha_de_campo_e_Database_Coleta_parametros_climaticos_comunitaria.xlsx
Storage of the data	Every three months, the sole coordinator for this monitoring activity collects the field sheets filled in the last three months by the community operators and concerns the transcription of the data collected in the database of the activity located in the *OneDrive cloud:* Ficha_de_campo_e_Database_Coleta_parametros_climaticos_comunitaria.xls x When collecting the field sheets, the sole coordinator for this monitoring activity, together with the community operators, implement a quality control of the data collected, taking care to correct any possible errors or inconsistencies found. A back-up copy of the database will be stored on the NAS (alternatively on the hard disk, or on the computer) for the storage of all data related to the monitoring system.
Needs Tr aining	For the collection of data in the field, an initial training of the data collectors is required, of 2 hours of training, implemented by the author of this descriptive sheet, or alternatively by the person responsible for the activity previously trained, on: - Organization and positioning of the equipment; - Method of data collection. A training meeting will be repeated each year to ensure the Consistency with the methodology in the implementation of the activity.
Work Effort	Each data collector dedicates 5 minutes a day to this activity. That means about 30 hours of work per year (ca. of 2.5 hours of work per month). Considering the five data collection sites, this means an annual effort of 150 hours of work to collect all the anticipated data. In addition, 40 hours of work per year are planned for the entry of the data from the field sheets into the database, as well as for the processing and processing of data for its return.
Estimation ma terial costs	The start-up costs for the activity can be summarized as follows: - 10,000 ECV for 5 digital thermometer-hygrometers (average life of 5 years, used 100% for this activity); - 4,000 ECV for 5 analogue rain gauges (average life of 8 years, used 100% for this activity) (possibly foresee the cost of carrying out by a blacksmith 5/6 supports suitable for keeping the rain gauges in a vertical position at a height of 1.5m); On this basis, long-life materials are considered to have an annual depreciation cost of around CVE 2,500/year. For annual implementation costs, this monitoring activity requires: - 8,000 CVE of gasoline for the 4 quarterly trips in the field, arriving at the five sites for the collection of tokens. - 4,000 CVE for data collection sheets and writing material. - 3,000 CVE to change the batteries of the digital thermometer-hygrometers. On this basis, it is considered that for the implementation of all data collection events in a monitoring year they require about 15,000 CVE. Finally, the sum of the amortization costs and the current expenses

Method monitoring	Collecting atmospheric climate data in communities
	required for one year of implementation of this monitoring activity assume a total of CA. of 17,500 CVE/year. No healthy staff the Considered here costs the costs of the of acquisition/operation of the car, and the costs of storing the data.
Baseline	The baseline for the indicators will be available after five full years of implementation of this monitoring activity.
Threats current information about the target of monitoring	Global factors contributing to accelerated climate change compared to pre-industrial times.
Bibliography	
Notes	It is strongly suggested to the implementing organizations to keep a reserve stock with at least 50% of the equipment necessary for the implementation of this activity.

3.5 PERMANENT QUADRANTS FOR THE MONITORING OF LAND COVER BY INTRODUCED AND POTENTIALLY INVASIVE PLANT SPECIES OF THE ORDER FABALES AND *TAMARIX SENEGALENSIS*

The method presented in this section is intended to comply with the following indication in Annex 1 of the ToR of the consultancy:
"2. To evaluate and map endemic vs invasive plant species e.g. ... Tarrafe (Tamarix senegalensis) ... Acacia... over-time."

A method of the typology presented in this section was strongly desired by the coordination team of the BIOPAMA project.
The consultant alternatively proposed the adoption of a method based on a mapping of land use, or vegetation (of basic type) of the target PAs. The suggestion is based on some considerations related to technical feasibility, concrete usefulness in terms of defining management choices, and the speed with which useful management results can be achieved with each of the two methodological approaches applied to the local context.
After an analysis of the pros and cons of the two methodological approaches, facilitated by the consultant, the coordination team confirmed its preference for the original methodological approach (i.e. quadrants for the study of vegetation). In accordance with this indication, the consultant has carried out the work requested by his ToR. The methodological result is described in the sheet included in this section.

Within the scope of the field test of the developed method, the measurement of the vegetation cover of the established quadrants using aerial drone photos and its georeferencing/digitization using a GIS software was experimented with. Applying some additional methodological attentions, described in this final version of the methodological sheet, the implementation of this technique provides the method in general with a consistency and a very high level of technical content. It remains to ascertain the ability of the local team to successfully manage a method of such a technical level, with a specific training for this method that was only developed over three days, two in the field and one in total in terms of theoretical classes and practical exercises with the GIS software.

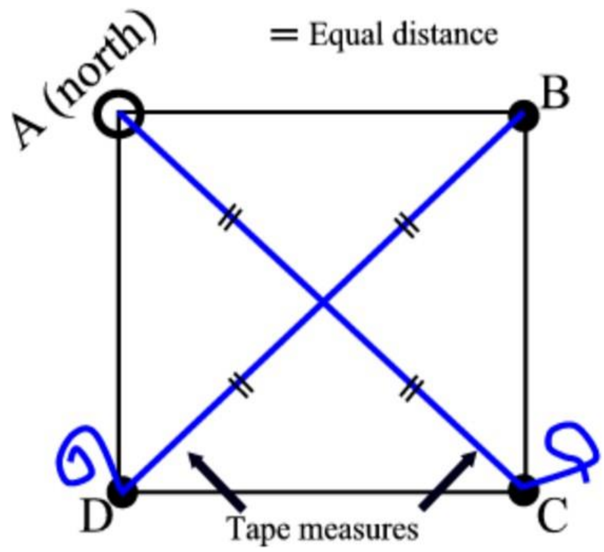
The following sheet was prepared by Dario Cesarini, with inputs by Andrea Brusaferro.

Method monitoring	Permanent quadrants for the monitoring of land cover by introduced and potentially invasive plant species of the Order of Fabales and *Tamarix senegalensis*

Level	1 - Technical-institutional.

Method monitoring	**Permanent quadrants for the monitoring of land cover by introduced and potentially invasive plant species of the Order of Fabales and *Tamarix senegalensis***
Target from monitoring	Stands of the native species *Tamarix senegalensis.* The stands of the introduced Fabales species (Arechavaleta *et al.*, 2005) shrubs, or arboreals, considered as potentially invasive in the ecological context of the island of Boa Vista. Among the species of Fabales introduced that are certainly present, the following are indicated: ⇒ *Prosopis juliflora* ⇒ *Leucaena leucocephala* ⇒ *Parkinsonia aculeata* Other species may be added to this list in time according to the evidence of the terrain. Similarly, species listed but never found in the study area may be eliminated from the list.
Key Target Attributes from monitoring	Capacity of the target species to occupy the soil/territory. For the purposes of this monitoring activity, the term "cover" is used as a synonym for occupation, which is considered as the vertical projection of vegetation from the ground seen from above. Therefore, "cover" is defined as vegetation that covers the surface of the soil. Viewable with a bird's-eye view of the vegetation.
The reasons for choosing the monitoring target	According to three different participatory evaluations, namely: - Bio-Tur GEF/UNDP/DNA Project in 2018, - Evaluation with IMET methodology in 2021, - BIOPAMA Project in 2023, the stands of introduced shrub and tree species, particularly those of the species commonly indicated as "acacias", were identified as one of the main threat factors for the stands of native plant species on the Island, with particular concern for the stands of *Atlantic Phoenix,* a species that seems to suffer in the competition for water resources and land occupation, with the listed species, especially in sandy substrates. *T. senegalensis* is a national and endangered species on the island of Boa Vista, being classified as Vulnerable (VU) in both geographical areas by the First Red List of Cape Verde (Gomes *et al.*, 1996).
The population, and/or the scope geographic that defines the monitoring target.	The stands of the target species located within the PNN and the RNT.

Data Collection Protocol	For a description of the methodology for the selection of the sites of application of the quadrants, see "Location of monitoring". <u>Establishment of the permanent quadrants of 20m x 20m and inherent data</u> The quadrant is located in the territory, viewing the specific project for this method, click on the *Qfield* software on the tablet/smartphone used for this activity. Once on site, the operators will try to get as close as possible to the point corresponding to the geographic coordinates of the quadrant centroid, indicated by the same basic view of the Qfield project digital map. An error in positioning of the metal centroid pile of about 1m knots is considered acceptable. North/South and East/West axes. The tip of the stake is stained with an ink

Method monitoring	**Permanent quadrants for the monitoring of land cover by introduced and potentially invasive plant species of the Order of Fabales and *Tamarix senegalensis***
	red spray. After positioning the station that marks the centroid of the quadrant, from it, the operators will go in a North direction (indicated by the compass), measuring with a measuring tape, or an electronic meter, the distance of 14.14m (Figure 1). In this place, they will place the metal stake that marks the north corner of the quadrant. The tip of the stake is stained with a grey spray paint. The same operation is repeated to locate the other three corners of the quadrant, measuring in the direction of the reminiscent cardinal points, but in this case, no metal stakes will be placed, while the corners of the quadrant will be provisionally indicated with piles of stones, or wooden stakes found on the site. The four corners of the quadrants are provisionally connected by a signal tape, as soon as the outer boundaries of the quadrants are evident to the operators. The operators ascertain that each side of the quadrant measures approximately 20m. An error of up to 1m is considered acceptable, although normally the error should be less than 0.5m. The tape will be removed at the end of data collection in each quadrant, and reused in the measurements of the next quadrant.  Figure 13: Support scheme for the placement of the standing quadrant on the ground. In the monitoring years following the pilot year, for each permanent quadrant, the team will check the presence of all the marks placed in previous years, and replace any missing marks. The information inherent to the quadrant is noted on the land sheet in the format Excel (<u>Fichas de campo e Database Fotoquadrantes invasoras.xlsx</u>). These are geographic coordinates, slope, altitude, soil type. It can be helpful to point out obvious objects, such as burnt tree stumps, trails, fences, and large rocks, to make it easier to relocate the quadrants. <u>Vegetation cover data collection</u> Once the establishment is completed, and the verification of the permanent quadrant, the team implements the data collection foreseen for the field sheet in format Excel

Method m onitoring	**Permanent quadrants for the monitoring of land cover by introduced and potentially invasive plant species of the Order of Fabales and *Tamarix senegalensis***
	(Fichas_de_campo_e_Database_Fotoquadrantes_invasoras.xlsx). For the specific recognition of the species included in the method, refer to: Target plant species recognition sheets The key data to be collected will be the soil cover of the target species for monitoring. For this purpose, the index proposed by Bailey & Poulton (1968) is used for land surveying, which is a variation of the more famous indices of Braun-Blanquet (1965) and Daubenmire (1959). The Bailey & Poulton index was considered to be more appropriate for the needs of this activity, and includes the following coverage classes: 0 – between 0 and 1% coverage 1 – 2 / 5% 2 – 6 / 25% 3 – 26 / 50% 4 – 51 / 75% 5 – 76 / 95% 6 – 96 / 100% These classes were determined to be reasonably repeatable absolute measures. By "cover" here we mean the amount of soil covered by the vertical projection of plant matter that can be visualized considering an aerial photograph of vegetation. All operators involved in the activity participate in the definition of the coverage values according to the Bailey & Poulton index, agreeing among themselves the value to be indicated in the land sheet for each target species present in the quadrant. Collection and analysis of quadrant photographs Once the quadrant and coverage data collection (Fichas_de_campo_e_Database_Fotoquadrantes_invasoras.xlsx) is completed, the team will proceed with the collection of the photographic image of the sample quadrant, using a drone. Before the drone is activated, operators will take care to fix plasticized paper cards on the branches or leaves of each of the patches of vegetation characterized by the presence of a certain species, using clips to hang clothes, or a similar tool. Each color of the cards will correspond to a species found. From the centroid of the quadrant, the drone should be placed in an afloat flight position. 30/35 m high to include the entire quadrant in a single aerial photo. The three operators will place themselves in three different corners of the quadrant before the photo is taken. To allow the correct georeferencing of the photograph taken with the drone, it is important that the operator positioned at the north vertex is easily distinguishable from the other two operators. This can be done by ensuring that the operator at the north end always has their arms open while the other two have their arms crossed. Alternatively, operators will always have to place themselves in the east, north and west corner, thus making the operator located in the north corner always recognizable. Once back in the office, each quadrant photo will be geotagged and its vegetation patches scanned using GIS analysis software (e.g. Qgis). The % cover of each species recorded in the field will be calculated and incorporated into the specific Excel sheet Of base from data This monitoring

Method monitoring	**Permanent quadrants for the monitoring of land cover by introduced and potentially invasive plant species of the Order of Fabales and *Tamarix senegalensis***
	(Fichas_de_campo_e_Database_Fotoquadrantes_invasoras.xlsx). In addition to providing a much more accurate measurement of vegetation cover compared to the measurement provided by cover classes, photographic documentation collected with drones or in a traditional way, as a standard component of monitoring, can in time document: 1. The location of the quadrants. Take photos in the parking lot and along the trail to the quadrant location to more easily find the site in the following campaigns. Photographs taken of quadrant boundaries can help allocate boundaries if markings are lost. 2. Vegetation cover. The photographs of the quadrants will be analysed in the office through any image visualization software on the computer and the team will be able to review the coverage values assigned in each quadrant, thus being able to identify and correct errors that occurred during data collection in the field. 3. By applying the same approach as in point 2., it will be possible to maintain consistency in the allocation of the coverage ratios defined in successive monitoring campaigns. 4. Population conditions. Flowering effort, herbivory levels, etc. are some of the conditions that can be illustrated with photographic documentation. Data analysis The person responsible for the activity of the Organization that coordinates the activity will have the role of annually preparing the monitoring outputs (i.e. calculation of the indicators), based on the final data collected by each organization partner of the activity.
Indicators for each AP included in the monitoring	n/a
Aggregate indicators	The Annual Monitoring Report shall include at least the following indicators for each target species: - Average % of coverage considering all quadrants measured. The Annual Monitoring Report shall include at least the following aggregated indicators for all target species as a whole: - Average % coverage considering all quadrants measured. - Estimation of the number of years needed to observe a variation > 20% of the aggregate vegetation cover of all target species in the sample quadrants. Provide the average value of the last three full monitoring events for all indicators listed above. Provide a graph of the temporal evolution over the years of the average values of the indicators listed above, from the first to the last year of implementation of the monitoring activity, with the graphical indication of the moving average of the last three monitoring events.
Indicators and additional data analysis	The Annual Monitoring Report should also include: - A map of the distribution of the measured quadrants with the indication of the cover class of the key species, and with the indication for each quadrant of the possible increase, decrease or lack of variation that occurred between the last two monitoring events. On an optional basis, the trends of the indicators in a horizon to 2040.

The Reasons Of	The selected indexes and methods are among the most widely used in the

Method monitoring	**Permanent quadrants for the monitoring of land cover by introduced and potentially invasive plant species of the Order of Fabales and *Tamarix senegalensis***
choice of the indicators	monitoring of the evolution of plant communities, and are also supported by an extensive scientific bibliography. One of the main advantages of choosing cover as a measure of vegetation is that it does not require identification of the individual (such as density), but is an easily visualized and intuitive measure (as opposed to frequency), thus being more suitable for field activities implemented by non-specialized teams. Among the three most common measures (density, frequency and cover), cover is also shown to be the most directly related to biomass. The use of quadrant coverage estimation is also advisable because of the ease and speed with which data can be collected. Coverage estimation is also more effective for locating and recording rare species (with coverage values of less than 3%) than point and line interception methods. The same indicators can be used to monitor other target species (e.g. endemic or endangered species), using the same permanent quadrants, and/or applying the same methodology in other areas of PAs. Permanent sampling units are chosen as they are more advantageous when there is a high degree of correlation between the values of the sampling units between two periods. This condition is expected to occur in this monitoring activity, and the target of monitoring is stands of trees, shrubs, i.e. long-lived perennials. Also, with permanent sampling units compared to temporary ones, statistical tests to detect changes from one period to the next are much more powerful than tests used on temporary sampling units. This advantage translates in this case into a reduction in the number of quadrants that need to be sampled to detect the same predefined magnitude of change.
Place Of monitoring	A single "key area" within the target PAs is selected on the basis of the highest predictable density of individuals of the target species (Figure 2). The chosen key area cannot be less than 20% of the sum of the surface area of the two target APs. Using this approach, we selected (subjectively) the key area that is expected to reflect what is happening in a wider area (Figure 2).

Method monitoring	**Permanent quadrants for the monitoring of land cover by introduced and potentially invasive plant species of the Order of Fabales and *Tamarix senegalensis***
	 Figure 14: Key area selected for the method. The key area of this method can be considered as the pilot territorial core, should this method be extended in the future to cover other stands and areas of interest for the management of the target sites. 40 permanent quadrants of 20m x 20m are randomly selected within the key area using the *grid-cell method* (Figure 3). In this way, the choice of quadrants is random, and no preconceived control determines where the quadrants are established. The only exception is that random quadrants in which roads and trails are present, or relevant constructions (e.g. buildings, etc.), should be discarded, because their interaction with the dynamics of vegetation cover would affect the results for the quadrant in question. The minimum distance between two quadrants cannot be less than 500m. It is necessary to provide for the possibility of replacing randomly selected quadrants, because of the inaccessibility of some areas of study.

Method monitoring	**Permanent quadrants for the monitoring of land cover by introduced and potentially invasive plant species of the Order of Fabales and *Tamarix senegalensis***
	 Figure 15: Location of the permanent quadrants.

It is not possible to make statistical inferences from the sampling of key areas for outdoor areas, because the key area was chosen subjectively. On the contrary, the random distribution of quadrants within the key area allows the statistical application of the monitoring results to the entire key area, provided that the minimum number of quadrants to be monitored is respected for this to be statistically acceptable. This minimum number is calculated according to the following formula: n = SE s2/d2, where:

n = number of quadrants

SE = Standard Error (SE = sd /sqrt n)

s2 = is the variance of the sample at a given time (the variance is the standard deviation squared)

d2 = is the square percent change that the sample needs to be able to detect (expressed as a difference in coverage).

The value of the minimum number of quadrants required to achieve statistical reliability of monitoring will have to be calculated at the end of the first pilot year of monitoring. The minimum number of quadrants indicated by the formula should be met by this method (e.g. if the formula indicated a minimum number of quadrants required to achieve the statistical reliability of 48 quadrants, so 8 more quadrants should be added to the 40 already measured).

Method monitoring	**Permanent quadrants for the monitoring of land cover by introduced and potentially invasive plant species of the Order of Fabales and *Tamarix senegalensis***
	For d2, it is suggested to indicate a minimum change in the coverage to be detected of not less than 10%, in order not to increase the number of quadrants to be monitored in an unfeasible way; and not more than 20 % because such a choice would excessively weaken the usefulness of the monitoring activity for the timely definition of management choices. An alternative formula to the previous one, but always applicable to this method because it is structured to provide the minimum sampling level to recognize a difference between two mean values between units of permanent sampling, is provided by Elzinga *et al.* (1998).
Frequency and period implementation	Data collection is fully implemented in all permanent quadrants every two years. Until the method will be limited to the group of target species indicated in this factsheet, the period of the year considered to be the most appropriate for the implementation of this activity is from April to June. This is because coverage measures are sensitive both to changes in number (mortality and recruitment) and in force (annual biomass production), and, therefore, the period prior to rainfall is considered as the one in which individual biomass should be less influenced by environmental factors (e.g. rainfall abundance and variability) and consequently more stable in different years.
Coordination with other monitoring activities	The field team will take with them the Qfield software project for collecting data on human activities and other pressures, recording the events relevant to that monitoring method.
Composition Of Team from monitoring	In the field, the working group will be composed of three operators: a person responsible for the daily activity, who also has the role of filling out the specific form for collecting data in the field, and two collaborators. The same team will jointly perform the GIS analysis of the photographic documentation collected with the drone. An activity manager who will have the role of coordinating and implementing the data collection at the selected sites, storing the collected data in the specific database for this monitoring activity and preparing the monitoring *outputs* (i.e. Calculation of the indicators).
Equipment of terrain	For fieldwork, it is necessary to: - A 4x4 vehicle - 2 smartphones/tablets (one for use, one for backup), with charged bacteria, and the Qfield software installed together with the specific project of this monitoring - Photo camera (can be the one from the smartphone) - A copy of the descriptive sheet of this method (i.e. this document) - A copy of the descriptive data sheets of the target species - Plasticized coloured cardboard papers of A6 form. Twelve pieces for each of five different colors - 30 clothes hangers (to be used to hang stained papers on plants) - Field Clothing - Artboards & Pens - First aid kit - Field Notebook - Electronic Pocket Distance Meter (EDMs; 0-50m, not less than 30m) - Two measuring tapes of at least 30m - Three packs of 100m signaling tape each

Method monitoring	**Permanent quadrants for the monitoring of land cover by introduced and potentially invasive plant species of the Order of Fabales and *Tamarix senegalensis***
	- Clinometer for tilt, height and vertical angle (can be the one in the software on the smartphone) - Compass (can be the one in the software on the smartphone) - Hammer for metal piles - Reusable Plastic Bags for Plant Sample Collection - Adhesive Paper Labels for Plastic Bags - 2 metal piles (the ideal would be posts with "T section", but they can be rebar for cement) of 30/40/50 cm in length for each quadrant to be established - 2 spray cans of different colors (red and grey) - A drone equipped with a photo camera - A digital photo memory of at least 32GB - A backup battery for the drone - 1 binocular It is recommended to store all, or most, of the equipment by establishing the quadrants in a box that can be taken to the field. This prevents forgetting an item and allows other methods to be tried if the planned method fails. For data analysis in the office, it is necessary to: - A computer with Excel and Qgis software installed, as well as any browser browser.
Field data collection sheets	There are two specific field sheets for this monitoring activity and one for the analysis of photographic data; all structured with the software Excel (Fichas_de_campo_e_Database_Fotoquadrantes_invasoras.xlsx).
Data storage	The sole coordinator for this monitoring activity, is concerned on a weekly basis with the transfer of the data collected in the database of the activity rented in *the OneDrive cloud:* Fichas_de_campo_e_Database_Fotoquadrantes_invasoras.xlsx In addition, the coordinator will synchronize the files changed during the field sessions with QField Cloud. Before implementing the transfer, the sole coordinator for this monitoring activity and the daily responsible for the activity in the last week, implement a quality control of the data collected during that day, taking care to correct any possible errors or inconsistencies found. The same operation is implemented after the analysis of the photographic documentation. A back-up copy of the database will be stored on the NAS (alternatively on the hard disk, or on the computer) for the storage of all data related to the monitoring system.
Needs Training	Initial training, implemented by the author of this descriptive sheet, is required on: - Introduction to the objectives, justifications, ways of implementing the method (2h). - Recognition of target species (2h). - Exercise to define the land cover classes (1h). - Two days of field trip to test the method and define the most correct way to fill in the field sheets, training the team for its implementation. - Georeferencing and digitizing the photographic documentation (4h). Next, a day and a half of discussion and training is required to take place every two years, prior to the implementation of the data collection campaign

Method monitoring	**Permanent quadrants for the monitoring of land cover by introduced and potentially invasive plant species of the Order of Fabales and *Tamarix senegalensis***
	in the field, to adjust any errors in data collection and ensure homogeneity in the application of the method among all the Organizations involved. This day and a half of periodic training should include a field trip day.
Work Effort	- For each permanent quadrant, it takes a median of 1 hour to reach the point of the reference coordinate, 20 min. For the establishment of the quadrant, 15 min. for filling out the field sheet and 10 minutes for the photographic record with drone. Therefore, each quadrant needs an average of 1h 45min of work to complete the related data collection. - To complete the biannual data collection campaign, 210 hours of work are considered to be required for the implementation of the activity in the field (40 quadrants x 1h 45min of work for each quadrant x 3 operators of the field team). - It is considered necessary 120 hours of work for the analysis of the photographic documentation and the introduction of the collected data in the specific database (40 quadrants x 1 hour of analysis for each quadrant x 3 team operators). - In addition, 16 hours of work per year are considered necessary for the preparation and preparation of monitoring outputs. The total working hours required to obtain the monitoring outputs with this activity is estimated to be around 346 hours/year (about 45 days, or 9 weeks, or 2 man-working months each year of implementation of the activity).
Estimation material costs	The start-up costs for the activity can be summarized as follows: - 20,000 CVE for a pair of binoculars (average life 10 years, used 5% for this activity); - 40,000 CVE for two smartphones (average life 4 years, used 5% for this activity); - 5,000 CVE for a laser meter (EDMs) (average life 10 years, 50% used for this activity); - 8,000 CVE for two measuring tapes of at least 30m (average life of 5 years, used 100% for this activity); - 8,000 CVE for a clinometer (average life of 10 years, used 100% for this activity); - 3,000 CVE for a metal hammer (average life of 10 years, used 100% for this activity); - 200,000 CVE for a drone equipped with a photo camera and digital memory (average life of 5 years, 20% used for this activity); - 2,500 CVE for a backup battery for the drone (average life of 5 years, used 20% for this activity); - 500 CVE for 30 clothespins. On this basis, long-life materials are considered to have an annual depreciation cost of around CVE 13,000/year. For annual implementation costs, this monitoring activity requires: - 15,000 CVE of petrol for 10 days of field travel. - 3,000 CVE for three 100m packets of signal tape. - 2,000 CVE for a set of reusable plastic bags for plant collection. - 1,000 CVE for adhesive paper labels for plastic bags. - 40,000 CVE here. 80 metal piles (the ideal would be posts with "T-section", but they can be rebar for cement) from 30 to 50cm of

Method monitoring	**Permanent quadrants for the monitoring of land cover by introduced and potentially invasive plant species of the Order of Fabales and *Tamarix senegalensis***
	length. - 1,000 CVE for two spray cans. - 4,000 CVE for laminated stained cards. On this basis, it is considered that for the implementation of all data collection events in a monitoring year they require about 66,000 CVE. Finally, the sum of the depreciation costs and current expenses required for one year of implementation of this monitoring activity will be taken into account in the total in ca. of 78,000 CVE/year. Personnel costs, personnel costs, acquisition/operation of the car, and the costs of storing the data.
Baseline	The *baseline* for the indicators will be available partially at the end of the first year of monitoring following the pilot campaign, and in full form after three campaigns of implementation of the activity.
Management Objectives	The management objectives will be defined after three full years of implementation of this monitoring activity, based on the data collected.
Current threats on the monitoring target	For *T. senegalensis* in Cape Verde, the main threats are habitat loss due to its transformation, and logging for firewood.
Bibliography	Arechavaleta, M., N. Zurita, M. C. Marrero & J. L. Martin (eds.). 2005. *Preliminary list of wild species of Cape Verde (hongos, terrestrial plants and animals).* Consejeria de Medio Ambiente e Ordenación Territorial, Gobierno de Canarias. 155 pp. Bailey, A. W., Poulton, C. E., 1968. Plant communities and environmental relationships in a portion of the Tillamook Burn, northwest Oregon. *Ecology* 49:1-14. Braun-Blanquet, J., 1965. *Plant sociology: the study of plant communities.* London: Hafner. Daubenmire, R. F., 1959. A canopy-coverage method. *Northwest Science* 33:43-64. Elzinga C. L., Salzer D.J. & Willoughby W. 1998. *Measuring and monitoring plant populations.* U.S. Department of the Interior - Bureau of Land Management, pp.492. Gomes I., Gomes S., Kilian N., Leyens T., Lobin W., Vera-Crus M.T., 1996. Red List for Angiosperms (Angiospermae). in Leyens, T. & Lobin W., (eds.) 1996. Cape Verde's first red list. *Courier Forsch.-Inst. Senckenberg*, 193: 1-140, 21 Figs., 23 Tabs.
Notes	This monitoring method was defined to answer general questions about the evolution of certain plant stands over time. It was not defined on the basis of specific management questions (e.g. to ascertain the effectiveness of a treatment applied to invasive stands). If, in its future evolution, it is restructured to meet specific management questions, it will have to be considered the identification of control quadrants, in which the management activities whose effectiveness is being measured, are not implemented. In case of application of this method to herbaceous and annual plant target species, the stratification and/or nesting of smaller quadrants (5m x 5m, or 1m x 1m) within the 20m x 20m quadrants may be considered, allowing a better coverage of vegetation variation using a Fewer quadrants, and less data collection effort.

Figure 16: The trainees finishing the installation of a 20x20m quadrant to follow the evolution of the vegetation of invasive tree species.

Figure 17: Group of trainees engaged in the recording of permanent quadrant data.

Figure 18: Use of the drone to take an aerial photo of the quadrant.

3.6 CORVUS RUFICOLLIS *COUNTING POINTS*

The method presented in this section is intended to comply with the following indication in Annex 1 of the ToR of the consultancy:
"1. To evaluate the impact of crows (Corvus ruficollis) on the fauna in PAs. (Behavioural Study)"

This was the method whose definition required the greatest effort by the consultant. It was also the method in which the invited expert, Andrea Brusaferro, provided his greatest technical-scientific contribution.

The first objective of the work was the preliminary definition of the potential impact targets of *C. ruficollis* pulation on the local fauna. In collaboration with the coordination team of the BIOPAMA project, and with P. Lopez (*pers. com.*), such potential targets were identified in:
- Reproduction of *Neophron percnopterus;*
- Reproduction of *Pandion haliaetus;*
- Reproduction of seabirds that nest on the island, especially on the islets around it;
- Reproduction of *Caretta caretta;*
- Reproduction and possibly adults of other bird species;
- Damage to domestic animals (especially goats and goats).

The possibility of directing the method to the measurement of the impacts on the population of *Neophron percnopterus* was rejected, and this species is practically extinct on the island.
The possibility of directing the method to the measurement of impacts on seabird populations was rejected because the period of the mission did not overlap well with the breeding heights of the different breeding species (S. Martins, *pers. com*.). The same situation occurs for the nesting period of *Caretta caretta.*

The impacts on other bird species were not considered, and these populations were evaluated as non-priority monitoring targets.
The consultant presented the possibility of developing and training the trainees for the implementation of a method of measuring the impacts of crows on domestic animals. This possibility did not receive unanimous approval by the coordination team, and being considered by the same consultant as a non-priority option, it was rejected.
The definition and implementation of a method to measure the impacts due to the population of *C. ruficollis* on the reproduction of *Pandion haliaetus,* was considered as the only really viable option at the time of implementation of the mission in the field (January-February), to meet the request of the ToR of the consultancy.

After a quick evaluation, the study technique identified as the most appropriate to arrive at the measurement of the selected monitoring target was camera traps. Thus, the contents of a methodological sheet based on the camera trap technique were developed and discussed with the coordination team. There was even a purchase of materials for the implementation of this method according to the methodological sheet delivered well in advance of the start of the mission in the field.

At the initial meeting of the mission, which took place on 22 January, between the consultant, the invited expert, and the coordination team, it was highlighted to the latter the need to "change", and/or replace the method described above, with another method that considered a more "populational" rather than a "behavioural" approach to the problem of crows on the island. The coordination team pointed to this need as the result of a previous misunderstanding. New references were made about the management questions that should be answered with the data and information provided by the implementation of the new method to be defined, and the target of the same was no longer, or not directly, the "*impact of crows*", as well as its nature of "*Behavioural Study*" should be changed to an occurrence/population study.

Throughout the first two weeks of the mission, with a work effort implemented outside the training schedule, and on weekends, the consultant, together with the invited expert, developed the method presented in this section, which was considered to be the most appropriate to answer the management questions indicated, and at the same time the most feasible for the local context.

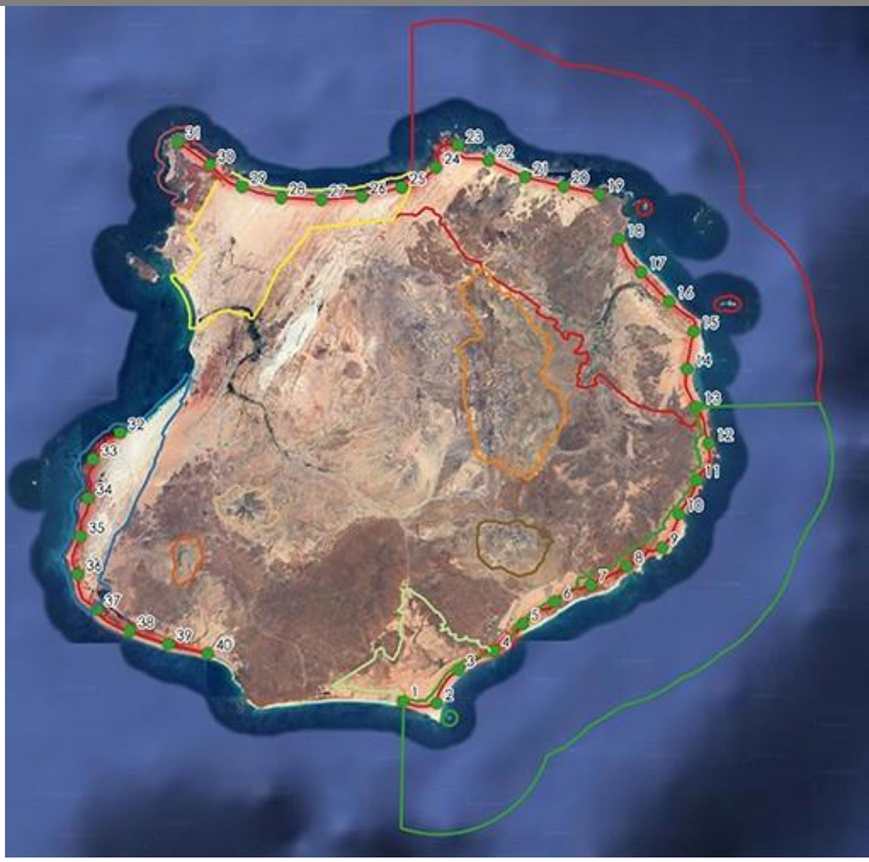
This fact sheet was prepared by Andrea Brusaferro and Dario Cesarini.

Method monitoring	**Corvus ruficollis *Counting Points***
Level	1. Technical-institutional.
Target from monitoring	Population of *Corvus ruficollis* and its predatory behaviors in populations of species of conservation interest.
Key Target Attributes from monitoring	The frequency of use of the target species, the areas of presence of the species of greatest interest for conservation that are also the target of predatory behaviors by *C. ruficollis.* Predation of *C. ruficollis* on species of conservation interest nesting in the coastal areas of the island of Boavista: *Pandion haliaetus,* *Caretta caretta*, seabird species, and the other possibility.
The reasons for choosing the monitoring target	According to i) technical reports on the follow-up of the population of *P. haliaetus* and its reproductive success (P. Lopez, 2018); ii) based on information from more recent similar studies (P. Lopes *pers. com*.), the predatory behavior of *C. ruficollis* was identified as the main cause, or one of the main causes, of the loss of reproductive potential of the P*. haliaetus population* on the island of Boavista. In addition, three different participatory evaluations implemented at the local level, namely: - Bio-Tur GEF/UNDP/DNA Project in 2018; - Evaluation with IMET methodology in 2021;

Method monitoring	**Corvus ruficollis *Counting Points***
	- BIOPAMA Project in 2023; The predatory behavior of *C. ruficollis* has been identified as a cause of loss of reproductive potential of the populations of many animal species, including those of relevant interest for the conservation of biodiversity on the island (*Caretta caretta*, seabird species, etc.). There is photographic and video evidence documenting the predation of *Corvus ruficollis* in the nests of *Sula leucogaster* and other seabird species on the island of Boavista and in the islets around it (Samir Martins *pers. com.).* In West Africa, ravens (*Corvus albus*) are well known as predators of newborn sea turtles (Catry *et al.,* 2010; Barbosa *et al.,* 2018).
The population, and/or the scope geographic that sets the target of monitoring.	The population of *C. ruficollis* on the island of Boa Vista.
Data Collection Protocol	The method is based on the Point *Count technique* by Bibby *et al.* (2000). <u>Identification of counting points</u> Along the largest sandy traces of the coastal perimeter useful for nesting turtles, observation and listening stations are identified by the systematic random method, placed at a distance of approximately 2 km from each other. <u>Implementation of Counting Points</u> The route between two consecutive stations is covered in a car by the operators. When the car approaches the station, the operators leave and walk the distance that separates the car from the right place whose coordinates correspond to the counting station. When it will not be possible to travel the transepts between two stations with a car on the ground, the operators will go on foot. At each station, the observation and listening period is 10 minutes, during which observers explore the surrounding area with binoculars at least 8x magnification. The presence of *Corvus ruficollis* in the study area is recorded as the number of contacts (visual and vocalization). During the implementation of the activity, the following data/information is collected in specific forms in Excel base for this monitoring method: - code of the watching/listening station; - date and time of the start of the countdown at each station; - weather conditions; - names of the operators involved in the activity; - AP where the station is located; - total number of contacts of *Corvus ruficollis*; - type of contact: visual, vocalization, nests; - observed behavior of *C. ruficollis* (perching, directional flight, circular flight, *mobbing*, hunting activity, predation); - in the case of predation, the target of predation; - simplified nesting codes by Meschini & Frugis (1993) (i.e.: possible, probable, possible, certain and their detail encodings); - presence of human activities; - Number of nests (yes/no), and number of contacts of *Pandion haliaetus* (and behavioral details;

Method monitoring	**Corvus ruficollis *Counting Points***
	- Number of contacts of species of the genus *Milvus*; - Number of contacts of *Sula leucogaster*; - Other comments. Nesting code keys *A. Nesting possible:* – Observation of the species during the breeding season – Male vocalizing during breeding season *B. Probable nesting* – Pair present in the habitat – Territorial behaviour – Material transport or nest construction *C. Right nesting* – Empty or recently used nest – Puppies – Adult arriving in a nest – Adult carrying food – Nest with flying juveniles – Nest with eggs During the observation and listening phase, operators should remain strictly silent, wear clothing appropriate to the surrounding environment, avoid strong colour contrasts and try to be as little visible as possible to the local fauna. The most appropriate time for the implementation of the activity is between 08:00 and 16:00, and it is possible to implement data collection in the maximum time interval between 07:00 and 17:00. During the same monthly monitoring session, the stations must be visited from number 01 to number 40. Individuals of *C. ruficollis* observed during the walking path from one station to the next one are recorded in the specific field of the data collection form from the counting station after the transect in question. Data analysis The data are entered into an Excel Database prepared for this purpose, where all the fields necessary for the analysis and collection of indicators are filled in. The information will be combined to create a GIS-based territorial information system. The person responsible for the activity of the Organization that coordinates the activity will have the role of annually preparing the monitoring outputs (i.e. calculation of the indicators), based on the final data collected by each partner organization of the activity.
Indicators for each AP included in the monitoring	The Annual Monitoring Report shall include at least the following indicators for each AP for the last monitoring station: ⇒ Average number of contacts per hour; ⇒ Frequency of contacts per month; ⇒ Frequency by type of predatory events per month; ⇒ Nesting status (possible, likely, certain) per month; ⇒ Logistic regression between *C. ruficollis* activities and human activities; ⇒ Behavioral ethogram of *C. ruficollis.* A map of nesting crows in the target area of monitoring. A map of the point indicators of abundance.

Method monitoring	Corvus ruficollis *Counting Points*
	The average value of all the indicators listed above, considering the last three years of monitoring and considering all years of monitoring, from the first to the last. Provide a graph of the temporal evolution over the years of the average values of the indicators listed above, from the first to the last year of implementation of the monitoring activity, with the graphical indication of the moving average of the last three years of monitoring.
Aggregate indicators for the island	The Annual Monitoring Report shall include at least the following aggregated indicators for the whole island for the last monitoring station: ⇒ Average number of contacts per hour; ⇒ Frequency of contacts per month; ⇒ Frequency by type of predatory events per month; ⇒ Nesting status (possible, likely, certain) per month; ⇒ Logistic regression between *C. ruficollis* activities and human activities; ⇒ Behavioral ethogram of *C. ruficollis.* A map of nesting crows in the target area of monitoring. A map of the point indicators of abundance. The average value of all the indicators listed above, considering the last three years of monitoring and considering all years of monitoring, from the first to the last. Provide a graph of the temporal evolution over the years of the average values of the indicators listed above, from the first to the last year implementation of the monitoring activity, with the graphical indication of the moving average of the last three years of monitoring.
Indicators and data analytics additional	A map of transect-related abundance indicators. Based on the data collected, it is possible to perform aggregation analysis spatial GIS.
The Reasons Of choice of the indicators	The number of contacts, in addition to the risk of predation, is the best indicator of the importance of a given area for a given species. In this sense, the number of contacts allows us to assess the relative importance for the population of the species in question between different areas, and different periods, in a given study area. The number of contacts does not indicate, nor does it aim to indicate the number of individuals present in the area (density), but it does indicate the frequency of use of the target species, it is not concerned with avoiding the replication of contacts in data collection. The frequency of use puts the focus on the data/information collected/provided at risk of the potential for preaction due to the individuals of the target species. Indicators related to *C. ruficollis* predation provide PA managers and other conservation actors with an indication of how much This behaviour is common and spatially widespread at the island level.
Place Of monitoring	40 counting points distributed in almost the entire coastal sector of the island, in a strip up to 300m from the coast (Figure 1). The island's coastlines characterized by the presence of cliffs, rocky or sandy coasts from 10 meters in height, as well as urban areas and areas with a high concentration of tourist reception infrastructures are excluded. The specific locations are defined according to the indications contained in the monitoring protocol.

Method monitoring	**Corvus ruficollis *Counting Points***
	 Figure 19: Location map of the 40 counting stations.
Frequency and period implementation	The monitoring frequency is monthly, taking care, compatible with environmental conditions, to carry out monitoring around the middle of the month (+- 10 days). If, for logistical reasons and long-term viability, a monthly frequency is not possible, the bimonthly frequency may still be compatible for the purposes of this activity.
Coordination with other monitoring activities	The information provided by this monitoring method would acquire an added value by its association with information provided by methods aimed at understanding the spatial distribution of populations of other species of interest for conservation on the island of Boavista, with particular reference to species with primarily coastal distribution (i.e. *Caretta caretta*, seabird species, *Pandion haliaetus*, etc.). The field team will take with them the Qfield software project for collecting data on human activities and other pressures, recording the events relevant to that monitoring method.

Composition Of Team from monitoring	On the ground, the working group will be composed of three operators: a person responsible for the daily activity, who also has the role of filling out the specific form for collecting data in the field, an employee who is constantly observing the environment, and a car driver. An activity manager who will have the role of coordinating and implementing the collection of data on the selected sites, of storing the collected data in the specific database for this activity of monitoring and to prepare the monitoring *outputs* (i.e. calculation of indicators) on an annual basis.
Equipment from	For fieldwork, it is necessary to:

Method monitoring	**Corvus ruficollis *Counting Points***
terrain	⇒ A 4x4 vehicle ⇒ Two binoculars (minimum 8x magnifications) ⇒ 2 smartphones/tablets (one for use, one for backup), with charged bacteria, and the Qfield software installed along with the specific project of this monitoring ⇒ A power bank ⇒ Photo camera (can be the one on the smartphone) ⇒ Terrain maps specific to this monitoring ⇒ A copy of the descriptive sheet of this method (i.e. this document) ⇒ Field Clothing ⇒ Artboards & Pens ⇒ First aid kit For data analysis in the office, a computer with installed Excel and Qgis software and any other browser browser.
Field data collection sheets	This activity requires a single field data collection sheet: Fichas_de_campo_e_Database_Pontos_contagem_Corvus.xlsx
Data storage	The sole coordinator for this monitoring activity, is concerned on a weekly basis with the transfer of the data collected in the database of the activity rented in the *OneDrive cloud*: Fichas_de_campo_e_Database_Pontos_contagem_Corvus.xlsx In addition, the coordinator will synchronize the files changed during the field sessions with *QField Cloud*. When implementing the transfer, the sole coordinator for this monitoring activity and those responsible for the daily activity of the last week, implement a quality control of the data collected, taking care to correct all possible errors, or inconsistencies found. A back-up copy of the database will be stored on the reference NAS (alternatively on the hard disk or computer) for the storage of All data related to monitoring system.
Needs Training	The members of the monitoring team must attend the training to: - introduce them to the objectives, justifications, ways of implementing the method and biology of *Corvus* (4h of training class); - two days of on-site training to test the method and train the team on its implementation; - the management of the database and the return of indicators (half-day training class).
Work Effort	- For the implementation of each counting point, an average of 40 min is considered. - Considering a total of 40 counting points, a total of about 27 hours of work in the field is expected to implement all the counting points foreseen in each monitoring session; - Considering the working time at 6 hours, 2 hours the time needed for travel to and from the locations in the field, five days of work are considered necessary for each monitoring session implemented for three members of the field team. - In addition, 80 hours of work per year are considered necessary for the elaboration and preparation of monitoring outputs. The total annual working days required to obtain the monitoring outputs with this activity, according to a monthly implementation frequency, would be around 190 days/year (or 38 weeks, or 8 man-working months each year of implementation of the activity).
Estimation ma	The start-up costs for the activity can be summarized as follows: - 40,000 CVE for two binoculars (average life 10 years, used 5% for

terial costs	

Method monitoring	**Corvus ruficollis *Counting Points***
	this activity); - 40,000 CVE for two smartphones (average life 4 years, used 5% for this activity); - 4,000 CVE to print and laminate terrain maps specific to this monitoring (average life 4 years, used 100% for this activity); On this basis, long-life materials are considered to have an annual depreciation cost of around CVE 1,700/year. For annual implementation costs, this monitoring activity requires: - Ca. 72,000 CVE of gasoline for field trips with monthly deployment frequency. On this basis, the sum of the depreciation costs and current expenses required for one year of implementation of this monitoring activity requires approximately 73,700 CVE in the case of monthly implementation. Personnel costs, personnel costs, acquisition/operation of the car, and the costs of storing the data.
Baseline	The baseline for the indicators will be available partially at the end of the first year of monitoring following the pilot campaign, and in full form after three campaigns of implementation of the activity.
Current threats on the monitoring target	n/a
Bibliography	Barbosa C., Patrício R., Ferreira B., Sampaio M., Catry P., 2018. Sea Turtles. In: Catry P, Regalla A (eds). *João Vieira and Poilão National Marine Park: Biodiversity and Conservation*. IBAP, Bissau. Bibby C.J., Burgess N.D., Hill D.A., Mustoe S.H., 2000 – Bird Census Techiques – Second Edition. London Academic Press; 257 pp Bolton M., *et al.* 2007. Remote monitoring of nests using digital camera technology. *Journal of field ornithology,* 78: 213 - 220 Catry P., Barbosa C. & Indjai B., 2010. *Guinea-Bissau sea turtles. Status, biology and conservation.* IBAP, Bissau. Meschini E. & Frugis S., 1993. Atlante degli uccelli nidificanti in Italia. *Suppl. Ric. Biol. Selvaggina*, volume XX. Gula R., *et al.,* 2010. An audio/video surveillance system for wildlife. *European Journal of Wildilfe Research*, 56: 803 - 807 Lopez P., 2018. *Boa Vista, bird, population monitoring, activities, summary, February 2018.* Technical report. Siverio M., *et al.*, 2014. Density, nest site characteristic and breeding rates of the osprey (*Pandion haliaetus*) in the southern limit of its range in the Western Paleartic (Boa Vista, Cape Verde Islands)
Notes	The data collected and the information processed may be used to define a control plan aimed at limiting the predatory impact of *C. ruficollis* on the reproductive potential of species of conservation interest.

Figure 20: Individual of *C. ruficollis* approaching operators during a counting section.

4. DATA STORAGE, SYNCHRONIZATION, QUERYING AND PROCESSING TOOLS

Associated with the methods introduced with this consultancy/training, a package of digital tools necessary for their correct and efficient implementation was developed.
Particular attention had to be paid to the issue that monitoring activities will be implemented contemporaneously by a set of Organizations (at least 3), and a variable number of operators on the ground, from 3/4 to 10/12 for each method. This was not a secondary matter to the consultant's work.

A Microsoft account has been created. Associated with that account is a OneDrive cloud that acts as a repository for all files that are directly useful for monitoring. The choice fell on the Microsoft tool, for greater compatibility with one of the software used (e.g. Excel). The Organisations involved can use this tool to consult an up-to-date version of the databases of the different ongoing monitoring activities.
The email associated with the Microsoft account can also act as a communication tool for the island's future "Monitoring System". The data inherent to the account created are:
Name: *Boavista Monitoring*
Email: boavista_pa_monitoring@outlook.com
Password: *given to the coordination team in a separate document*

On the OneDrive delivered consultant prepared:

A folder with all the methodological sheets finalized after testing the methods in the field.
It is essential that all staff involved in the implementation of a method have a good knowledge of the final version of the specific methodological sheet.
In this folder, files were also placed for the recognition of plant species targeted by monitoring.

A folder with all the presentations of the methods and other topics used during the training classes. Presentations of the methods were prepared prior to the field test and the preparation of the final version. Therefore, in case of inconsistencies between the completed methodological form and the presentation, only the completed methodological form should be considered.
Presentations of GIS tools and, above all, *Qfield Cloud*, can act as an operational roadmap for the monitoring team.

A folder with the final versions of the method databases in Excel format with spreadsheets for simplifying the return of indicators and the data collection sheets in the field in Excel format.
These in OneDrive are the "official" (and shared) Databases for all methods and all Organizations. Each single coordinator of a monitoring method will be able to work on updating the DBR offline on a work computer, but will take care to update at least weekly the "official" file shared in the specific OneDrive folder.
In addition, the Organizations involved are advised to equip themselves (at least one of them) with their own NAS, and to use a folder of this equipment with the periodic back-up function available online for all partners involved in the monitoring activities.
For methods in which the land sheets are based on Excel, land sheets and databases have coincident structures. This means that in the field work a copy of the database can be used, but always saving the "original/official" copy in OneDrive, and at least somewhere else (e.g. a computer, and/or hard disk/NAS). Once the data collection is finished in the field, the sole responsible for the activity manually copies and pastes only the new data records from the Excel file used in the field, to the "official" Excel database. That's a maximum of once every week.

Only the method of collecting climate data from the communities has a paper field sheet.

For the methods in which the field sheets are based on the *Qfield* application, after having updated the *Qgis* project, through *Qfield Cloud* with the synchronization function, it will be necessary to manually copy and paste the data contained in the .dbf file into the "official" Excel database for its update. In this case, synchronization through *Qfield Cloud* will have to be daily, to make the most of its potential. The update of the "official" database in Excel, in this case, may have a weekly frequency, or possibly monthly, whenever a back-up copy of the Qgis folder contained in OneDrive is updated weekly, external to OneDrive.

The databases delivered to the aforementioned OneDrive incorporate all the collected data compatible with the final version of the method until February 17th.

OneDrive also incorporates a folder with the GIS project and all the GIS files required for the implementation of the set of monitoring methods introduced.
In principle, the monitoring team should not touch anything in this folder. The overall *Qgis* project should work as a base project and not receive manual changes, but only via synchronization from Qfield *Cloud*. That's why a *Qfield Cloud account has also been created:*
Website login: https://app.qfield.cloud/accounts/login/
Account name: boavista
Password: *given to the coordination team in a separate document*
Associated email: boavista_pa_monitoring@outlook.com
In principle, the monitoring team should not touch anything in this cloud, but it is essential to use it so that the entire synchronized work system between organizations, teams and their devices in the field works.

A Qgis Cloud *account has not been created*, and at this stage it is a tool that Organizations do not need to properly and fully implement their monitoring activities. If in the future they want to use this tool to communicate the results of the monitoring to partners external to the system, it will be possible to do so, but at the moment the consultant prefers to focus the focus of the trained teams on data collection and processing, rather than on their communication to the outside.

5. SHARING OF RESULTS OF MONITORING ACTIVITIES

Hockings *et al*. (2006) show how scientists and researchers, who concentrate much of their activities on the work of study and analysis, often underestimate how long it took them to develop the capacities associated with their work; They easily end up assuming that most people have the ability to define meaningful information from large amounts of data. This is not what is usually the case in reality, and the ability to interpret data is an important part of the skills that must be developed in an evaluation process.
An effort that the consultant considers important in the context of the construction of an ecosystem monitoring and evaluation system on the island of Boavista, is to have developed indicators in advance for all the chosen monitoring methods. In the first place, this approach has certainly helped the trained local technicians to develop their own skills to identify the key information that the managers of a territory must obtain as a result of a great effort consisting of dozens, sometimes hundreds, of days of data collection in the field and thousands of data entered into the databases. Secondly, it is strongly believed that this approach will significantly facilitate the work of local technicians to transform the collected data into such relevant information, without the continuous need to resort to the support of the consultant or senior researchers.

Within the scope of this consultancy, an information sharing and management tool was also developed for the ecosystem monitoring system of the two target PAs. This tool is based on the *Miradi Shares* (https://www.miradishare.org/ux/home) platform.
It is a particularly suitable tool for sharing data and information between the organizations implementing the monitoring activities, and possibly sharing it with other organizations with a technical profile in the field of conservation. It is not a suitable tool for sharing data and information with institutions in general, and even less with audiences outside the system.
The consultant created two projects, one each of the two target PAs, filled in a general description of the ongoing initiative, developed some baseline analyses in the projects (e.g. the situational models incorporated in this report), while other analyses were developed as a result of the trainees' group work (i.e. threat analysis, which would deserve to be reviewed in detail by a senior professional with a background in this type of analysis).
The structure and use of the platform was the subject of a 2-hour theoretical/practical training session. It is likely that this training will not be enough to make the local team autonomous in the use and management of the platform.
To access the projects created, it is necessary for the Partner Organizations to create their own account on the *Miradi Shares platform*, using names easily identifiable by the consultant (e.g. Tartaruga Boavista Foundation, Cape Verde Natura 2000 Boavista, Bios.CV Boavista, DMAA Boavista, etc.). Once the account of each organization involved in the monitoring system has been created, the consultant will have to be notified, and will send the invitation to access the projects on the online platform to the accounts created.
At the moment, the cost of using the platform for these projects is covered by the consultant. In the medium/long term, if this tool will continue to be used by the organizations involved, one of them will have to take "ownership" of the projects, and consequently the associated costs to keep them on the platform. Once the operation of the tool is learned, each Organization, with its own account, will also be able to create other projects on the platform, according to its needs, following its rules and tariff plans.

In addition to the use of the *Miradi Shares* platform, the consultant suggests, at the very least, to prepare an annual monitoring report, for the shared return of the results of the monitoring work implemented within the framework of this initiative.
Ideally, in January of each year, the information from all the partners involved in the implementation of the monitoring system should be collected (the target of the monitoring system should be officially defined, and at the moment you can refer to the methods introduced with the BIOPAMA project), and to return it through the report (no later than February of each year).

year to refund the results obtained for the previous year).

The report will incorporate the values of the indicators for the past year, as well as the related management tools and considerations (maps, additional relevant information, changes in methods, deductions on the evolution of resources and pressures, suggestions on how the information generated should address management activities, etc.).

6. EVALUATION

Two different evaluations of the training were implemented, both using surveys given to the trainees, namely:

1. Evaluation of training in terms of logistics, performance of trainers, and achievement of the recommended objectives.
2. Self-assessment of the level of knowledge perceived by the trainees in the themes addressed by the training.

6.1 EVALUATION OF TRAINING

The trainees filled out the surveys anonymously. Table 8 shows the results of the evaluation based on the answers of the trainees at the end of the training course.

Table 8: Assessment results based on trainees' responses.

Questions		SATISFACTION LEVEL						
		0%	25%	50%	75%	100%	Media	*n*
1	The place where the course was held was suitable for this activity?				3	7	**93%**	*10**
2	The time chosen for each training meeting Was it suitable?		1		5	5	**82%**	*11*
3	The duration of each training meeting was Proper?			2	2	7	**86%**	*11*
4	The preliminary knowledge you had was Enough towardsunderstand the Arguments dealt with?	1	1		8	1	**66%**	*11*
5	The arguments dealt with were pertinent to the theme general training?				3	8	**93%**	*11*
6	The training was able to provide the information and knowledge foreseen by the initial objectives?				5	4	**86%**	*9**
7	The Trainers Got stimulate and To give motivation in deepening the subject?			1	2	8	**91%**	*11*
8	The trainers were able to explain the arguments Clearly?			1	3	7	**89%**	*11*
9	The Trainers Were Available towards Additional clarifications and explanations?			 1	 4	11 6	**100%**	*11* *11*
10	Are you interested in the arguments covered in this course? training?				4	6	**86%**	*10**
11	**Overall, are you satisfied with this course?**				4	7	**90%**	*11*
	Think than Formations Performed with this							

* - Some trainees did not answer these questions.

The result of the evaluation seems clearly satisfactory, with all the components that received an evaluation of the level of satisfaction of the trainees above 80%. The availability of the trainers to provide additional clarifications and explanations is highlighted, in which 100% satisfaction was achieved by the trainees (question number 9). Also the overall satisfaction rating, with an average rating of 90%, is very high (question number 11).

It is evident that two trainees realized that they did not have the necessary preliminary knowledge to be able to make the best use of this training (question number 4).

In the free answers, three trainees indicated the need to have a broader GIS training component, while two trainees suggested that it would have been better to anticipate the time of field trips.

6.2 SELF-ASSESSMENT OF THE LEVEL OF KNOWLEDGE OF THE TRAINEES IN THE SUBJECTS TARGETED BY THE TRAINING

The survey inherent in this assessment was completed by the trainees twice, the first time at the beginning of the training, the second time at the end of it. Table 9 shows the results of the self-assessment in these two stages. The universe of the result presented is composed of the nine trainees who completed both the initial survey and the final survey, namely: Emílio Landim, Inilton Tavares, Diana Semedo, Ruben Taccola, Ailton Andrade, Silvério Santos, Jailson Martins, Jorge Semedo, Nelson Semedo.
The counting point method for crows was not evaluated to the extent that the initial survey had been prepared considering the camera trap method initially envisaged. The change of program that took place on the same day as the beginning of the training did not make it possible to evaluate this method, which was defined only two weeks after the beginning of the training.

Table 9: Results of the self-assessment.
Trainees had to answer the listed questions by choosing one of the following values:
1 = Null/nothing; 2 = Scarce/very little; 3 = Intermediate/more or less; 4 = Advanced/relevant; 5 = Complete/Fully

Questions	Initial Average Assessment	Average final evaluation	Differentiates
How do you rate your level of knowledge general upon the monitoring of Protected Areas?	2,6	3,2	0,7
How do you assess your level of knowledge and understanding about the conservation values of Boavista's PAs?	2,3	3,2	0,9
How do you assess your level of knowledge and understanding of the threats to conservation values present in Boavista's PAs?	2,2	3,2	1,0
How do you assess your ability to implement a Census of arboreal plant species?	2,0	3,6	1,6
How do you assess your ability to implement a monitoring method based on the recording of activity occurrences? Human?	2,1	3,4	1,3
How do you assess your ability to implement a quadrant-based monitoring method for tracking Evolution of vegetation cover?	2,0	3,8	1,8
How do you assess your ability to implement a monitoring method based on the measurement of fishing effort and the Measurement of biometric parameters?	2,1	3,4	1,3
How do you assess your ability to implement a Monitoring based on climate data collection with community operators?	1,9	3,0	1,1
How do you assess your ability to manage databases to support the Ecological monitoring?	2,1	3,3	1,2
How do you assess your database management skills? (GIS)?	1,9	2,9	1,0
How do you assess your level of platform knowledge for the Management of conservation projects between different partners?	2,3	3,3	1,0
Overall average	2,1	3,3	1,2
How do you rate your previous experience in monitoring Areas? Protected?	2,4	n/a	
In general, how much do you think this training has improved your Ability to implement ecological monitoring methods?	n/a	4,4	

The self-assessment of the trainees also gave clearly satisfactory results.
In general, trainees perceived that they had moved from an average assessment of skills close to scarce (2.1), to an average assessment of skills slightly higher than intermediate

(3,3).
The monitoring methods in which the trainees perceive that they have reached the most robust level of skills, and also the maximum increase in knowledge compared to their pre-training levels, are the permanent quadrants for vegetation and the census of endangered tree species.
The areas in which the trainees perceive that they have reached the least robust level of skills are the management of GIS databases (which was not a priority target of the training), and the collection of climate data with community operators. For this second method, the consultant admits that, since the training program is very dense, he chose to "sacrifice" the training in the field for this method, having a more simplified technical content compared to the other methods to be introduced.
The answer to the general question about how much the training improved the trainees' abilities to implement ecological monitoring methods was also very positive, with the average of the individual evaluations being 4.4, i.e. intermediate between "relevantly" and "fully".

Table 10 shows the individual answers of the trainees to the question about which would be the two monitoring methods so that the trainee feels more interest, or more personal vocation, among those who were approached by the training. Organizations involved are advised to take these responses into account when defining some type of specialization in structuring data collection in the field. Interestingly, the method on the fisheries biology of whelk-goat seems to have achieved the most interest by most of the trainees.

Table 10: Individual answers of the trainees to the question about which would be the two monitoring methods so that the trainee feels more interest, or more personal vocation, for its implementation among those who were approached by the training.

Forming*	NGO	Tree Census	Invasive quadrants	Crows Counts	Fisheries biology whelk	Human Activities and Pressures	Climate Parameters
Ailton Andrade	TF			■	■	■	
Emílio Landim	TF		■			■	
Inilton Tavares	TF			■	■		
Jorge Semedo	CVN2000	■			■		
Kenydjeer Rodriguez	CVN2000		■		■		
Silverio Santos	CVN2000				■		
Diana Semedo	BIOS	■			■		
Nelson Semedo	BIOS	■			■		
Ruben Taccola	BIOS	■		■	■		

* - Jailson Martins (TF) did not express preferences; Rafaela Tavares (TF) was not present on the last day of training.

7. ADDED VALUE AND FUTURE OPPORTUNITIES

More generally, the greatest opportunity represented by this initiative is that a technical-operational base has been created for the development of an ecosystem monitoring system on the island of Boavista.

Not secondarily, considering the background of the local context, this initiative, and more generally the BIOPAMA project, represented a reason for collaboration and synergy between different Organizations, which goes beyond the work of sea turtle conservation, which is the "comfort zone" of at least two of the four Organizations involved.

In order for the path in this direction to continue, first of all, it is necessary to ensure a financial flow that allows the continuation of the work effort started within the scope of the financing of the BIOPAMA project.

From a technical point of view, if the Organizations involved intend to consolidate this approach (i.e. create and implement an ecosystem monitoring system at the island level, or at least at the level of the island network of PAs), the consultant's understanding is that to optimize the future path, it is necessary to develop a structured work of framework, planning and capacity building, also adopting a more participatory approach.

In the short- and medium-term, the possible stages of the process of continuing the work initiated could foresee:

⇒ Improvement and/or expansion of the target of the methods in progress of implementation (e.g. sexual recognition of *Persististrombus latus*, mapping of marine fishing areas for whelk, creation of synergies with other ongoing monitoring activities, etc.). The methods of vegetation quadrants and crow counting may cover many more species than only the target species covered in this first phase. In the case of birds, in order to include data collection on all species in the method, it is necessary to implement four or five additional training days in addition to those implemented during the training course. In the case of plant species, in order to include in the method the collection of data on all the species potentially present, in addition to the introduced Fabales and *T. senegalensis*, it is necessary to provide the skills of a botanist with a good knowledge of the national flora. Local organizations can also try to take "opportunistically" advantage of existing competences at the national level (e.g. N. Ramos, R. Freitas, M. Abu-Raya, etc.), when these appear at the island level.

⇒ Senior technical support during the first 6/18 months of implementation of field collection and data storage activities. It could be optimized by taking place by bi-monthly follow-up steps.

⇒ GIS training by two technicians selected from each partner organization of the monitoring system. It would require a course of theoretical classes (1/3 of the time) and practical classes (2/3 of the time) of about 60/80 hours of training. Annex B sets out the content that should not require any such training.

⇒ Completion of the analysis of environmental priorities at the island level, or at least of the entire island system of PAs. This analysis was partially implemented for the two PAs targeted by the BIOPAMA project, it would be a matter of completing it for these two and extending it to the others. Alternatively (and it would be the solution that the consultant would advise), a single analysis can be developed for the entire system of APs on the island and uses it as a basis for the construction of a single monitoring system for the entire island network of APs.

⇒ Develop a gap analysis of the current monitoring system of the island's PAs. This stage preliminarily provides for the completion of the work described in the previous point, and incorporates (i) a mapping of the actors implementing environmental and socio-economic monitoring activities on the island (i.e. "overt and less overt" activities); (ii) an inventory of ongoing environmental monitoring activities on the island and related indicators.

⇒ Prepare a *roadmap* that defines the implementation of a participatory process for the integration in a framework of joint restitution of the results of the measurement of the environmental and socio-economic variables of the Island.

⇒ Implementation of the most urgent steps identified with the work in the previous point. Right

It relates in particular to the introduction of the two or three monitoring methods that prove to be the highest priority on the basis of the gap analysis to be implemented.

⇒ Support for the operationalization and technical follow-up of the project on the *Miradi Share Platform.* This may foresee the eventual merger of the two current projects structured by APs, in a single project for the entire network of APs of Ilha da Boavista, or eventually in two projects, one for the marine component and one for the terrestrial component of the AP network.

⇒ Senior technical support in the preparation of the first, and eventually the second, annual monitoring report.

⇒ In 2025, implementation of a second PA assessment exercise based on the IMET methodology. On this occasion, consider the possibility of developing a single exercise for the entire island network of PAs. This step would also include in the monitoring of PAs the levels of the assessment framework described in Section 2., which are neglected by an approach that considers "only" the measurement of environmental and socio-economic parameters (i.e. level of impacts).

⇒ Consider the possibility of creating *a baseline* with other technical-methodological tools to evaluate the effectiveness of PA management.

One of the monitoring methods introduced offers potential added value in the case of its relationship with ongoing studies and monitoring activities on the island.
The most evident case is that of counting crows, also because it was structured with this idea of relating different data. The association of the frequency data of this species with the presence data of the conservation targets in the study area would provide important information for the definition of the areas of greatest potential impact, and of greatest interest in the case of implementation of *C. ruficollis* control programs. The study area of this method was defined in order to look for the maximum potential overlap with the distribution areas of the predation targets of greatest interest for conservation by *C. ruficollis.*
The threat and human activity logging method, implemented opportunistically when noteworthy activities/occurrences occur, can easily be associated with many terrain activities of various natures. This will slowly but steadily provide useful data to the Partner Organizations. Data that, prior to the introduction of this method, were not used in an organized way for use in management purposes.

Partly related to the subject discussed above, the consultant underlines the scientific potential of one of the monitoring methods introduced.
Monitoring the fisheries biology of the whelk is a method that certainly has this potential, as long as the local team finds a way to incorporate the sexual recognition of individuals into the methodology. According to the consultant's understanding, this is the only missing data for this monitoring work to have a full scientific consistency. On the other hand, the added value in terms of support for the management of this method would derive from the association of morphometric measurement with fishing areas in the marine environment. After a period of one or two months of collaboration on the implementation of the method with the divers, the local team should try to work with them on the definition and mapping of fishing areas, possibly through the use of GPS, or similar tools.
Due to the importance in terms of international conservation of *Phoenix atlantica*, and the importance of the Boavista stands for the conservation of the species, the results of its monitoring through the method of census of individuals, can certainly be the subject of a scientific publication.
The method of crow counting points itself has a management utility, with little scientific potential. On the contrary, the association of the results of this monitoring with the results of other studies related to the resources targeted by their predation (*C. caretta, Calonectris edwardsii, P. haliaetus, Phaethon aethereus, N. percnopterus, Sula leucogaster,* etc.), would have scientific potential, in addition to constituting an important added value for the definition of management activities.
The permanent quadrant method for tracking soil cover by introduced and potentially invasive plant species may have scientific potential, but only after having data collected for a minimum period of 6/8 years. In this case, the greatest scientific interest in this type of study would be in the experimentation of a relatively innovative method, with relatively few references in the scientific literature (i.e. measurement of quadrant coverage

by its digitization). In this case, the scientific potential of the method would be consolidated/enhanced by the extension of the method to all species present in the permanent quadrants.
The reminiscent methods do not have the potential to be the subject of scientific publications.
In all the cases listed above, the consultant, as well as the invited expert, are available to collaborate with the implementing Organizations to achieve the publication of scientific articles on the basis of the data collected with the methods developed and introduced within the scope of this consultancy. It is normal practice throughout the world for the authors of a scientific method to be involved in this type of purpose, especially on the basis of the consideration that the work effort of the specialists was partially, or completely, of a voluntary nature.
The prerequisite for these considerations is that the implementing Organizations are able to (i) give the monitoring activities continuity over time, and (ii) ensure the technical-scientific quality of the data collected in the field.

The consultant wants to underline that the space for the classes provided by DMAA (at no cost to the project) was absolutely functional for the needs of the training. Perfection would have been achieved with the availability of internet.

Another reason that provides a strategic value to the collaboration of Prof. Brusaferro in the framework of the project (see § 1.3) is that, by relating the interest of the Organizations that implement the monitoring activities with the research interests of a specialist, it is possible in the medium term to obtain technical and scientific support, which would otherwise be difficult to obtain in the same way by the consultant. or without additional financial resources.
This collaboration may continue after the delivery of this report, according to the modalities chosen by the Organizations involved in the BIOPAMA project, and Andrea Brusaferro.

Figure 21: The group of trainees during an exercise with GIS software taught by A. Brusaferro.

8. CONSTRAINTS

The constraints encountered during the mission in the field, and the consultancy in general, starting with the most relevant, are described below.

The monitoring methods targeted by this training have been carefully evaluated and planned in order to reduce their implementation costs at a minimum. However, monitoring activities have costs that will inevitably have to be covered in some way beyond the short-term ensured by the BIOPAMA project.
It is estimated that the monitoring activities introduced with this initiative have a combined implementation cost of 300,000/350,000 CVE/year (approximate cost considering the periodic replacement of the necessary equipment and the costs associated with the implementation of the activities in the field, Section 3.). To these costs must be added the costs related to the acquisition and maintenance of means of transport, and the equipment/office supplies necessary for data management. In addition, it is necessary to consider the approximate cost of 25 monthly salaries for the remuneration of technical staff implementing the planned monitoring activities (Section 3.).
The financial sustainability of these activities is the No. 1 issue that Organizations should be concerned about in the immediate future.

Despite the impressive tourist development and transport connections above the national average, Boavista is still a "peripheral" island, of an oceanic archipelago, located in West Africa, which is in turn the region whose countries have the lowest average human development indicators in the world. As is usually the case in contexts of geographical isolation, limited population size, and difficult access to university-level training, the number of technicians available at the local level, and especially those trained in the environmental field, is extremely limited. The job market at the national level offers more attractive opportunities for trained technicians than the island of Boavista can offer. The permanence on site of trained and qualified personnel for the implementation of the monitoring methods introduced with this capacity building activity is a potentially very great constraint for the long-term coherence and sustainability of this valuable initiative.

Annex 1 of the ToR indicates a set of work scopes that includes the task of developing at least 6 to 10 monitoring methods, depending on possible technical choices.
Four weeks of mission in the field means having about 20 days available to train a team of 12 technicians, with different levels of background scope. Considering about 8 methods to be introduced, this means that the ToR provides an average of two and a half days of training, theoretical and practical, for each method to be introduced. And this is without considering any introductory class, and/or framing of the trainees in technical areas in which they have a professional experience that, at best, is limited.
The consultant trained (handing over some tasks to another professional in parallel) the team of trainees for the implementation of 6 methods, curating them from their ideation, to training for the elaboration of data. It is believed that the maximum possible was achieved by the time available, the needs of the trainees in relation to the selected methods, and as indicated by the ToR. However, 1 or 2 additional days of training for each method introduced, would have been very useful to consolidate the capacities of the trainees and collect some additional data, especially with the aim of fine-tuning the methodologies and related tools (particularly the structures of the databases and restitution of indicators).
A useful reflection for the future may be to consider that a whole week of training, or almost (i.e. 4 or 5 days), is necessary for each monitoring method to be introduced (this also depends on the technical complexity of each method). In this way, with four weeks of mission, it would be reasonable to implement the training for 3, maximum 4 methods, with a few more days available for the necessary framing and complementary classes.
The biggest risk associated with choosing to introduce many new methods in such a short time is that trainees may know how to implement six methods more or less well right away, rather than knowing how to implement three or four of them right away.

A piece of data collected and stored must be analyzed by GIS tools. These are tools that require a fairly high level of specific knowledge, trained staff and some form of expertise within the monitoring team. On the island of Boavista, it is not easy to ensure the availability of this type of skills in the long term.
The consultant, but above all the invited expert, implemented several training sections to provide the trainees with the minimum skills necessary to ensure the short-term implementation of the methods introduced.
In the medium and long-term, it is essential that partner organizations have at least two technicians on their staff who have an intermediate level of training in the management of GIS software (see Section 7 and Annex B), and in addition to data collection software.

The lack of a conceptual and methodological framework upstream of the choice of targets and, consequently, of the monitoring methods, ended up giving the consultant a somewhat "naïve" perception of his own work. However, some tools were developed within the framework of this work, to explain the technical justification of the choices made by the reference organizations. The trainees participated with several group works in the development or validation of these tools, and it is considered that this contributed positively to the evolution of their understanding of the island's conservation issues, and their engagement in training and monitoring activities.

The consultant did not have access to technical or scientific documentation produced by the Organizations involved within the scope of their current and past monitoring and study activities. Such access, in some cases, could have at least:
- facilitated the path to arrive at the identification of the most appropriate methodological approach for the local context, taking advantage of the field tests taken with previous experiences.
- From the knowledge of the results of other studies, we used to define the areas of study for the methods to be introduced (e.g. counting the crows).
- leveraged from existing *baselines*.
- Positively fed some technical analysis (e.g. target priorities, and threat analysis).
In the context of this work, this was a secondary constraint, but in case this is a typical occurrence of the context, some of the steps for the future development of the island monitoring system, as outlined in Section 7., would not be feasible.

There is no evidence, and it is unlikely, that some methods introduced with this training were implemented in Boavista previously. This situation is reflected in the impossibility of structuring *baseline* data for most indicators before at least 2-3 years from the beginning of their measurement, and more generally, prevents you from having relevant information for management choices before this deadline. This is not the ideal situation to give donors short-term motivation. The only real exception to the picture described is represented by the method of census of endangered tree species, and to a lesser extent, by the method of fisheries biology of the whelk.

The computers used by GIS exercises and other data management software did not have proper keyboard formatting, nor were they equipped with mice, making practical classes in this area inefficient and particularly tiring for trainees and trainers.

Some of the trainees, especially those who do not have a biological/environmental background, but not only, showed a partial knowledge of how to act during work activities in the field. Some of the evidence that leads the consultant to this assertion can be listed as follows:
- Little attention to not damaging substrates with conservation value;
- Little attention to not altering the measurement site (displacement of plant parts, noise confusion, etc.)
- Inadequacy of the individual equipment at the time of starting the field trips that foresee the transport of drinks and food for lunch and rehydration.
- Inadequacy in the shoes to walk on the terrain for 4/6 consecutive hours.

- A common attitude is to always take the cars as close as possible to the place where the field activities are carried out, even when this involves some damage to the native vegetation. On the other hand, the consultant noticed a certain common attitude on the part of the trainees, in the careful management of the field equipment of their Organizations.

The respective Organizations should provide a mini-training to their technical staff, of 1 or 2 hours, on the behavior of the bandstand in the bush, and the preparation of field trips that take another 4 hours, or more.

APPENDIX A – BIBLIOGRAPHY

The following bibliography only includes the references cited in this document outside the methodological sheets. The bibliographic references of the documents cited in the methodological sheets can be found in the specific section of the files in which the document is cited.

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ANNEX B – CONTENTS FOR A SPECIFIC GIS TRAINING COURSE

According to an informal request from the BIOPAMA project manager, the following are the contents suggested by the consultant to develop a GIS training.
The training could be aimed at selected personnel from the Organizations of the BIOPAMA project (e.g. two or three technicians for each Organization). The following contents were identified taking into account the priorities of the Organizations involved and the typology of use of GIS, within the scope of ecosystem monitoring systems.
The contents indicated can be the subject of a 60/80h training course, between theoretical and practical classes, which could be implemented for two weeks.

Contents for a GIS training course in the context described

GIS Fundamentals: Definitions and Fundamental Concepts
Components of a GIS Main
applications
Main vector and raster GIS formats (ESRI Shapefile, GeoPackage, Geotiff, CAD, etc.) Reference
Systems (SR), Reference Ellipsoids, Datums, and Projection Systems Major SRs (e.g. WGS 84 UTM,
ETRF2000 UTM) and EPSG codes for Cape Verde Map classification (basemaps, thematic)
Data Structure: Raster and Vector
Digital Elevation Models (DEM, DTM and DSM)

QGIS Desktop Software Installation
Procedure SR System Management in
QGIS
Panels and toolbars
Inserting and Managing Raster and Vector Layers How to
search and install plug-ins
Main plugins in the QGIS environment
Map navigation tools Managing layers in
the legend Geodata visualization and
theming

Creating New Layers
Geometry Creation Mode
Vector editing tools and options (drawing, adjustment, advanced scanning tools) Widgets for data entry
Creating a point layer from text files (x,y,z) Thematic practice exercises

The QGIS Geotagger Plugins for
Geotagging Geotagging a map
Inserting Ground Control Points and Transform Settings Error Evaluation
Thematic practical exercises

Data processing and subtitles
Symbology for Single, Categorized, and Graded Symbol Style
Management
Geodata labeling Thematic
practical exercises

The Database: Opening and Using Attribute Tables
Selecting Objects and Connections to Access and Excel Databases

The Structure of Databases
Data Types
Editing tables
Creating and Editing Fields
Basic Statistical Analysis on Tabular Data Querying and
Updating Tabular Data
The QGIS Field Calculator
Thematic Practice Exercises

The QGIS print composer: interface and main features
Layout Generation Printing
Procedures

Vector and Raster Data Manipulation
Geoprocessing Tools Geometry Tools
Analysis Tools Search Tools
Thematic Practical Exercises

Spatial Analysis (rudiments)
Spatial Point Pattern Analysis Kernel
Analysis