

Characterising São Tomé and Príncipe’s artisanal fisheries through participatory, smartphone-based landing surveys

Consultancy report for the Blue Action Project:
“Establishing a network of marine protected areas across São Tomé and Príncipe through a co-management approach”



Catch of a demersal longline, Hospital Velho, Príncipe Island (2018, © Guillermo Porriños)

Report prepared by Guillermo Porriños (independent consultant, December 2019)
Version in Portuguese available [here](#)

TEAM **Guillermo Porriños** (Independent consultant for *Fauna & Flora International*)
Luisa Madruga (Project coordinator, *Fauna & Flora International*)
Manuel da Graça, “Lindo” (Príncipe, *Fundação Príncipe*)
Albertino Santos (São Tomé, *MARAPA*)
Litoney Matos (Príncipe, *Fundação Príncipe*)
Lodney Nazaré (São Tomé, *Oikos*)
Sinaida Espírito Santo (São Tomé, *MARAPA*)
Bastien Loloum (São Tomé, *Oikos*)



Table of contents

This document has been structured in two independent reports: 1) report on the activities related to the implementation of smartphone-based, participatory landing surveys in São Tomé and Príncipe, conducted between the 15th of May and 28th of December as part of a consultancy contract between Fauna and Flora International and Guillermo Prieto Porriños; 2) scientific report, with a detailed description of the methods, results and recommendations.

Implementation of participatory, smartphone-based landing surveys in 20 coastal communities in São Tomé and Príncipe REPORT ON ACTIVITIES	I
A. INTRODUCTION.....	I
B. OBJECTIVES.....	I
C. OUTPUTS.....	II
Output 1. Design and preparation.....	II
Output 2. Training.....	III
Output 3. Data collection and analysis.....	IV
Output 4. Outreach.....	IV
Characterising São Tomé and Príncipe’s artisanal fisheries through participatory landing surveys and smartphone technology SCIENTIFIC REPORT	1
INTRODUCTION.....	1
METHODOLOGICAL APPROACH	1
Study site	1
Rapid assessment of fishing gears and fished species	4
Training and recruitment of the interviewers.....	4
Landing surveys.....	4
Consent and confidentiality	10
Cleaning and assessment of the data quality.....	10
Data analysis	11
RESULTS	11
Assessment of training and data quality	12
Socio-economic dynamics of the landings	12
Artisanal fishing boats.....	12
Fishing gears and techniques.....	13
Effort and Catch-Per-Unit-Effort	22
Catch.....	24
RECOMMENDATIONS AND CONCLUSIONS	29
REFERENCES.....	31
ANNEXES	32
Annex I: fishing communities in Príncipe island	32
Annex II: fishing communities in São Tomé	33
Annex III: Species’ list.....	34
Annex IV: Assessment of the work of extension workers – training phase.....	39
Annex V: Criteria for the assessment of data quality	40
Annex VI: Assessment of Príncipe’s data quality.....	41
Annex VII: Assessment of São Tomé’s data quality	42
Annex VIII: Protocol for processing the data.....	43



List of figures

Figure 1: Fishing communities in Príncipe Island. Note that Hospital Velho is divided in four communities or “neighbourhoods”: São João, Concom, Unitel, and Água Namoro.	2
Figure 2: Fishing communities in São Tomé.....	3
Figure 3: A) Lindo conducting a test during the recruitment process; B) Full-day training of the extension workers at the fisheries department in São Tomé. C) Litoney (centre of the picture) and Lindo (right) supporting the extension workers during the training to conduct an interview; D) Extension workers of Malanza and Porto Alegre explaining the activity to the fishers (see Consent and confidentiality, page 10). Pictures by: Litoney Matos, Fundação Príncipe (A); Lodney Nazaré, Oikos (B); Guillermo Porriños (C and D).	5
Figure 4: Questions of the landing surveys questionnaire. In grey, the questions regarding <i>general information of the fishing trip</i> ; in green, questions related to the <i>catch</i> ; in blue, the <i>indicator species’ length</i> and in orange, questions related to the <i>gear and effort</i> . White squares are questions only meant to facilitate the flow of the interview and are removed in the data processing.	7
Figure 5: Screenshots of the landing surveys questionnaire: A) Filter used to find the species; B) and C) Questions to record information on catch, its use and the price.	8
Figure 6: Screenshots of the landing survey questionnaire: A) Time that the fisher started and finished fishing; B) Information on the gear used; C) What species were caught with the gear.	9
Figure 7: Examples of pictures of the indicator species collected by the extension workers. A single picture per indicator species is taken, covering at least 9 individuals in the picture (if available). Each of the cells of the grid used as a reference for size is 11 mm. The species are A) <i>Dasyatis</i> sp. and B) <i>Lutjanus fulgens</i>	10
Figure 8: types of net fishing in São Tomé and Príncipe (© Guillermo Porriños)	15
Figure 9: A) Fisher from Abade (Príncipe) going drifting-gillnet fishing; B) Purse seine fishing in São Tomé. Pictures by Guillermo Porriños.....	15
Figure 10: types of line fishing in São Tomé and Príncipe.....	19
Figure 11: A) Catch of a demersal longline troll, mainly composed of blue runner (<i>Caranx crysos</i>), fulu fulu and small specimens of <i>Seriola rivoliana</i> (almaco jack). B) Fisher from Hospital Velho returning after using a set demersal longline. To avoid the entanglement of the line, the hooks are nailed to a wooden table in an organised way, as shown in the picture. C) “Vega”, a bent wooden stick acting as a spring, which is attached to the anchor of the demersal handline and used to shake the line and spread the smell of the bait. The weight is located before the hooks, to keep the part of the line bearing the hooks in parallel to the bottom. Pictures by Guillermo Porriños.	20
Figure 12: A) Device used to attract the flying fish; B) Small fish caught using mosquito net; C) Diver catching octopus with an iron rod. Pictures by G. Porriños.	21
Figure 13: Percentage of trips going for each type of fishing in Príncipe.	22
Figure 14: Types of line fishing in Príncipe island.....	23

List of tables

Table 1: Average weights of species sold by number of fish, and frequently not weighed by the extension workers. All the fish of each species coming from a single fishing trip were weighed together.	11
Table 2: Catch Per Unit Effort units of the main categories of fishing gears in Príncipe, adapted on recommendations from fisheries monitoring by FAO (2004).	11
Table 3: Types of net fishing in São Tomé and Príncipe.....	14
Table 4: Description of gears and techniques used for line fishing in São Tomé and Príncipe.....	16
Table 5: Other types of fishing in Príncipe. Fishing types marked with an asterisk (*) are not included in the landing surveys. See Santos et al (2017) for a more exhaustive classification of the gears.....	21
Table 6: contribution of the main types of fishing to the total number of fishing trips per day	22
Table 7: Number of daily trips in Príncipe of the main categories of fishing, disaggregated by community.	25
Table 8: Catch Per Unit Effort, weight of fish caught per gear and gross profit of the fish sales per trip for Príncipe island, disaggregated by gear. Rows coloured in grey should not be used as an indicator, due to low sample size. Right column (Q) refers to the quality of each category as an indicator, being 0 (red) not recommended as an indicator; 1 (yellow) recommended as an indicator, although further data analysis is needed; 2 (green) recommended as an indicator.....	26
Table 9: Catch Per Unit Effort, weight of fish caught per gear and revenue of the fish sales per trip for São Tomé island, disaggregated by gear. Rows coloured in grey should not be used as an indicator, due to low sample size. Right column (Q) refers to the quality of each category as an indicator, being 0 (red) not recommended as an indicator; 1 (yellow) recommended as an indicator, although further data analysis is needed; 2 (green) recommended as an indicator.....	27
Table 10: Average catch per trip, disaggregated by fishing gears, and daily and annual estimations of fish landed In Príncipe island.....	28
Table 11: Robustness of each gear’s CPUE as a fisheries indicator.	30



Implementation of participatory, smartphone-based landing surveys in 20 coastal communities in São Tomé and Príncipe

REPORT ON ACTIVITIES

A. INTRODUCTION

Smartphone-based, participatory landing surveys have been implemented in 20 coastal communities of São Tomé and Príncipe (STP) as part of the project “Establishing a network of marine protected areas across São Tomé and Príncipe through a co-management approach”, led by *Fauna & Flora International*, in partnership with *MARAPA*, *Oikos - STP* and *Fundação Príncipe*, and funded by *Blue Action Fund* and *Arcadia Fund* (The Blue Action Project).

The Blue Action Project follows up on the activities of the projects *Kike da Mungu* (São Tomé) and *Omali Vida Nón* (Príncipe). The landing surveys’ protocol has been based on the method developed by *The University of Exeter* and *Fundação Príncipe* during the *Omali Vida Nón* project (2016-2019, funded by Darwin Initiative). Landing data is collected Tuesdays and Fridays by extension workers (fishers or fish traders from the communities themselves), and two questionnaires are used for collecting landing data: a questionnaire for interviewing the fishers and a questionnaire to record whether the interviewers were able to collect data that day or not. For the Blue Action Project, smartphone technology has been implemented to collect these data, and the questionnaires have been expanded.

Landing data were collected in six and three communities in Príncipe and São Tomé respectively during the projects *Omali Vida Nón* and *Kike da Mungu*. For the BAF Project, sampling has been expanded to 20 communities. In **São Tomé island**, the communities of *Ribeira Afonso*, *Angra Toldo*, *Angolares*, *lô Grande*, *Praia Pesqueira*, *Ribeira Peixe*, *Monte Mário*, *Malanza*, *Porto Alegre* and *Ilheu das Rolas* have been included; and in **Príncipe island**, the communities of *Abade*, *São João*, *Unitel*, *Concom*, *Água Namoro*, *Santo António*, *Burras*, *Campanha*, *Ribeira Izé* and *Lapa* have been included.

The activities and results reported in the present document were conducted as part of a consultancy contract between *Fauna & Flora International* and Guillermo Prieto Porriños conducted between the May 15 and December 28, 2019, funded by Blue Action Fund and Arcadia Fund.

B. OBJECTIVES

- 1) Finding smartphone-based methods suitable for collecting landing data;
- 2) Developing and implementing a smartphone-based protocol for collecting landing data to be used by fishers and fish traders from 20 fishing communities in São Tomé and Príncipe;
- 3) Training extension workers on collecting landing data and assess their progress;
- 4) Producing Catch Per Unit Effort (CPUE) estimates for São Tomé and Príncipe;
- 5) Producing summaries to return the data to the fishing communities;
- 6) Providing recommendations for future monitoring and assess the method’s limitations.

**Landing surveys in São Tomé and Príncipe
ACTIVITIES REPORT**

C. OUTPUTS	
Output 1. Design and preparation	
Output 1.1.	Assistance and purchase of materials , including: 1) Listing materials that need to be purchased out of the São Tomé and Príncipe, finding sellers online and transporting the materials to the country; 2) Listing and preparing materials that can be purchased in country, to be purchased by the local team.
Output 1.2.	Assessment of fishing gears : including: 1) Literature review on fishing gears existing in the country; 2) Nine semi-structured interviews with fishers from five communities in Príncipe to describe all fishing gears and its names; 3) Eleven Focus-Group Discussions (FGD) with extension workers and fishers at each of the 10 project communities, showing a slide show with a representation of all the fishing gears and its variations known for São Tomé and Príncipe, to understand the different names given to each fishing gear and whether each gear is used at each community (slideshow available here , ©Guillermo Porriños).
Output 1.3.	Assessment of fished species and local names : including: 1) Literature review on fished species; 2) Three semi-structured interviews with marine guards and the field coordinator to determine the local names of the fished species for Príncipe; 3) Nine FGDs at the project’s communities in São Tomé with a slide show of 100 fish species described for STP (available here) to discuss how often these species are caught and which are the vernacular names for those species.
Output 1.4.	Selection of indicator species : The indicator species are those of which the extension workers need to take a scaled picture with the tablet to allow measuring. Species were selected according to one or more of the following criteria: 1) Species characterised as “vulnerable”, “nearly threatened” by the IUCN red list (i.e. <i>Thunnus albacares</i> , <i>Thunnus obesus</i> , <i>Balistes punctatus</i> , <i>Balistes capriscus</i>); 2) Species which are often misidentified by the extension workers (i.e. flatfishes, lutjanid snappers); 3) Species of special fisheries or ecological relevance (i.e. snappers, groupers and seabasses, sharks and rays, parrotfishes...); 4) Species representative of the different fisheries (i.e. demersal species caught by demersal longlines and vertical handlines; pelagic species caught by surface trolls, etc.)
Output 1.5.	Meetings with the fishers from the communities in São Tomé to present the activity and list of the fishers’ names : 1) Ten workshops with the fishers and the extension workers in the presence of two project coordinators. Meetings were held in the ten communities where the landing surveys are being implemented during the days 7 th , 8 th and 9 th of August. The extension workers of each community presented the activity to the fishers and explained the protocol for data collection, including the protocol to ensure confidentiality of the data. Fishers were invited to participate in the surveys and the names of those who wanted to participate were listed, so as to include them in the fishers’ list of the ODK questionnaires. 2) Allocating random codes to the fishers of each community to ensure the confidentiality of the data.
Output 1.6.	Quick assessment of smartphone applications suitable for collecting landing data , namely Open Data Kit (ODK) and OurFish (June 2019).
Output 1.7.	Development of ODK questionnaires for collecting landing data : including the following versions: 1) <u>Version 0, Príncipe</u> (June 30, 2019), developed with the local field assistant (Lindo) and local assistant coordinator (Litoney), to be tested in the field during the training sessions. Several intermediate versions were created during July to adapt the questionnaire to the different landing scenarios and facilitate data collection; 2) <u>Version 1, Príncipe</u> (July 30, 2019) first version of Príncipe’s ODK landing questionnaires, which was used by the extension workers to collect Príncipe’s landing data in August and September; 3) <u>Version 0, São Tomé</u> (August 10, 2019), developed in collaboration with São Tomé’s extension workers during the first training session, which was updated several times during the subsequent training sessions to adapt the questionnaires to the different landing scenarios; 3) <u>Version 1, São Tomé</u> (September 15, 2019) first version of São Tomé’s ODK landing questionnaires, which was used to collect São Tomé’s landing data in September, October and November; 4) <u>Version 2 for Príncipe and for São Tomé</u> (October 31, 2019), developed in order to update the species and fishers, and include a new gear, as well as change some options to facilitate data

**Landing surveys in São Tomé and Príncipe
ACTIVITIES REPORT**

collection and prevent the most common errors detected in the data collected with the first versions of the questionnaires.

Output 2. Training

Output 2.1. Recruitment of extension workers by Fundação Príncipe, Oikos and MARAPA. In Príncipe, recruitment and selection of extension workers was led by Litoney Matos and Lindo (Fundação Príncipe) and done in June 2019; and in São Tomé it was led by Albertino Santos (MARAPA) and Lodney Nazaré (Oikos) and done in July 2019.

Output 2.2. Training needs assessment in Portuguese and in English (June 2019), available [here](#).

Output 2.3. Training extension workers in Príncipe, including: **1)** Three-hour workshop at Fundação Príncipe to introduce the activity to the team. Participants included 10 extension workers recruited by Fundação and a representative of the fisheries department. The workshop was mediated by Guillermo Porriños, the field and coordination assistants (Litoney Matos and Lindo) and the project coordinator (Luisa Madruga); **2)** Sixteen 4-hour training sessions (48 hours) were delivered at the landing sites in groups of 3-4 people, in which the use of the ODK was explained and different landing scenarios were practised, engaging the fishers in the activity. Each extension worker received 16 hours of training.

Output 2.4. Training extension workers in São Tomé (August and September): including: **1)** Whole-day workshop (8h) at the fisheries department to introduce the activity to the team. Participants included: 10 extension workers recruited by MARAPA and OIKOS, two project coordinators (OIKOS) and two representatives of the fisheries department; **2)** Fifteen training sessions (5h each) in groups of 1-3 people, delivered to each extension workers at their communities, in which the use of ODK questionnaire was explained and different scenarios were practised. In total, 75 hours of training were delivered, and each extension worker received 4 to 6 training session at the landing sites. **3)** Development of a subjective assessment tool to monitor the development of the extension workers throughout the training (see Annex IV of the Scientific Report).

Output 2.5. Training team leaders in São Tomé and Príncipe: Two team leaders in São Tomé (Albertino and Sinaida) and two in Príncipe (Lindo and Litoney) were trained in order to ensure a continuous support of the extension workers after the training was over. Team leaders in São Tomé joined two whole-day training sessions during the 23rd and 24th of September and team leaders in Príncipe joined 12 four-hour training sessions during July.

Output 2.6. Continuous support of the extension workers by the team leaders: Activity led by Lindo (Príncipe) and Albertino and Sinaida (São Tomé).

Output 2.7. Production of 5 handbooks on using and setting up the landing surveys' ODK questionnaires: Including: **1)** Handbook for configuring and updating an Android smartphone, installing ODK, downloading questionnaires into the device and sending data to the server (October 2019, [version for distribution](#)); **2)** Two handbooks for using the questionnaire for landing surveys ([Príncipe, v.1, Aug. 2019](#); updated to [Príncipe, v.2, Dec. 2019](#) | [São Tomé, Oct. 2019](#)). **3)** Two handbooks for using the questionnaire for recording the presence at work and the number of boats ([Príncipe, v. 1, Aug. 2019](#); updated to [Príncipe, v. 2 Dec. 2019](#) | [São Tomé, Oct. 2019](#)).

Output 2.8. Assessment of extension workers' performance and data quality (September and October 2019): including: **1)** Cleaning and analysing landing data, in order to detect and correct the most common mistakes, using data from August and September (Príncipe) and October (São Tomé). In total, 120 hours; **2)** Calculating the percentage of surveys completed correctly using the 23 criteria described in Annex V of the Scientific Report); **3)** Summary of the most common mistakes committed by each extension workers into a document to be handed to each of them; **4)** Final workshops with the extension workers and the team leader at the end of the extension workers' probation period to explain the most common mistakes committed during the data collection. [Príncipe](#): 4-hour workshop at FP's office (2nd of October); [São Tomé](#): Ten individual meetings at the extension workers' communities (12th, 13th and 14th of November).

**Landing surveys in São Tomé and Príncipe
ACTIVITIES REPORT**

Output 3. Data collection and analysis	
Output 3.1. Data collection:	1) In total, 1008 fishing trips were successfully recorded in Príncipe from August to December 2019 by the 10 extension workers; 2) In total, 268 fishing trips were successfully recorded in São Tomé from September to November 2019 by the 10 extension workers.
Output 3.2. Cleaning:	In total, 327 instances (Príncipe) and 44 instances (São Tomé) were cleaned during September and October 2019. Cleaning included: 1) Development of an Excel book that automatically re-organises the variables, discarding the empty or redundant variables (for example, questions that are only meant to facilitate the flow of the interview) and splitting the data into three different databases: i) general information of the fishing trip; ii) fishing effort; iii) catch; 2) Manually cleaning the data in Excel by fishing trip.
Output 3.3. Defining methods,	namely 1) researching standard measures of fishing effort by fishing gear to calculate Catch Per Unit Effort; 2) Researching image processing software for measuring distances in scaled pictures to measure fish length.
Output 3.4. Analysis:	Detailed description of the analyses in page 1 of the Scientific Report, including: 1) First Catch Per Unit Effort estimates for São Tomé and Príncipe, using standardised effort measures defined by FAO; 2) Description of the catch by gear; 3) Estimation of the gross and net profit per fisher, trip and gear.
Output 3.5. Report-writing:	This report (October – December 2019)
Output 4. Outreach	
Output 4.1. Training sessions with representatives of the fisheries department:	One theoretical session and one practical session in the field in Príncipe during July 2019; and one day of training at the fisheries department in São Tomé, with two representatives of the statistics department.
Output 4.2. Summarising landing data to return to the communities:	Production of 2 summaries (in Portuguese) to be distributed to the communities (available here).
Output 4.3. Presentation at the fisheries department:	On November 19, 2019 the method and preliminary results of the project were presented at the fisheries department. Thirteen representatives of the fisheries directorate were present, including a representative of the head of the department. The presentation was mediated and introduced by Albertino Santos and Sinaida Espírito Santo (MARAPA) and Lodney Nazaré (Oikos-STP). The presentation (in Portuguese) can be downloaded here .



Characterising São Tomé and Príncipe's artisanal fisheries through participatory landing surveys and smartphone technology

SCIENTIFIC REPORT

INTRODUCTION

Globally, artisanal fisheries contribute to 50% of the landed fish, and in West Africa, the fishing effort of the artisanal fishing fleet is three times higher than the effort of the industrial fishing fleets operating in the region (Belhabib *et al.*, 2018; Cashion *et al.*, 2018). Small scale fisheries are also one of the main sources of protein and income for many coastal communities in rural areas all over the world (Jacquet and Pauly, 2008). However, despite its global importance, artisanal fisheries are often underrepresented in the fisheries statistics (Graaf *et al.*, 2011). Although understanding the socio-economic dimensions of artisanal fisheries is essential for its management; national-level data remains scattered and incomplete (Mills *et al.*, 2011). FAO's voluntary guidelines for securing small-scale fisheries (2015) highlight the need for "*investing in small-scale fisheries research through collaborative and participatory data collection*", as well as "*developing capacity [within] small-scale fishing communities to participate in research and in the utilization of research findings*".

In São Tomé and Príncipe, the entirety of the fishing fleet is artisanal (Tous, 2015), and nearly 20% of its population is employed in the artisanal fisheries sector (UNDP, 2013). Fish is one of the main sources of protein in the country, and the archipelago is amongst the world's most dependent countries to fisheries (Barange *et al.*, 2014).

Participatory landing surveys using the open-source smartphone app Open Data Kit have been implemented in 20 communities in São Tomé and Príncipe as part of the project "Establishing a network of marine protected areas across São Tomé and Príncipe through a co-management approach", funded by *Blue Action Fund* (the "Blue Action Project")

METHODOLOGICAL APPROACH

Study site

Landing data is being collected in 20 communities in São Tomé and Príncipe. For each community, one extension worker was recruited by the project to collect landing data. In Príncipe island, landing data is currently being collected in the communities of *Abade, São João, Unitel, Concom, Água Namoro, Santo António, Burras, Campanha, Ribeira Izé* and *Lapa* (all the permanent fishing communities or "neighbourhoods" in Príncipe, see Annex I and Figure 1). Two other temporary ports have been also included: *Praia de Novo* (data is collected by the extension worker or *Ribeira Izé* when the community migrates there) and *Praia Seca* (data is collected by the extension worker of *São João*, and *São João's* data is collected by *Unitel's* extension worker during this time). In São Tomé island, landing data is being collected in 10 permanent coastal communities in the South-East of the island: one community of Cantagalo District (*Ribeira Afonso*); and the nine fishing communities of Caué district: *Angra Toldo, São João de Angolares* (or *Angolares*), *Iô Grande, Praia Pesqueira, Ribeira Peixe, Monte Mário, Malanza, Porto Alegre* and *Ilheu das Rolas* (see Annex II and Figure 2). The South-West coast of the island is of difficult access, mainly occupied by few small, temporary communities of palm winemakers. The Southern fishing grounds are also used by fishing communities in the North, but these communities were not included in the surveys.

Landing surveys in São Tomé and Príncipe
SCIENTIFIC REPORT

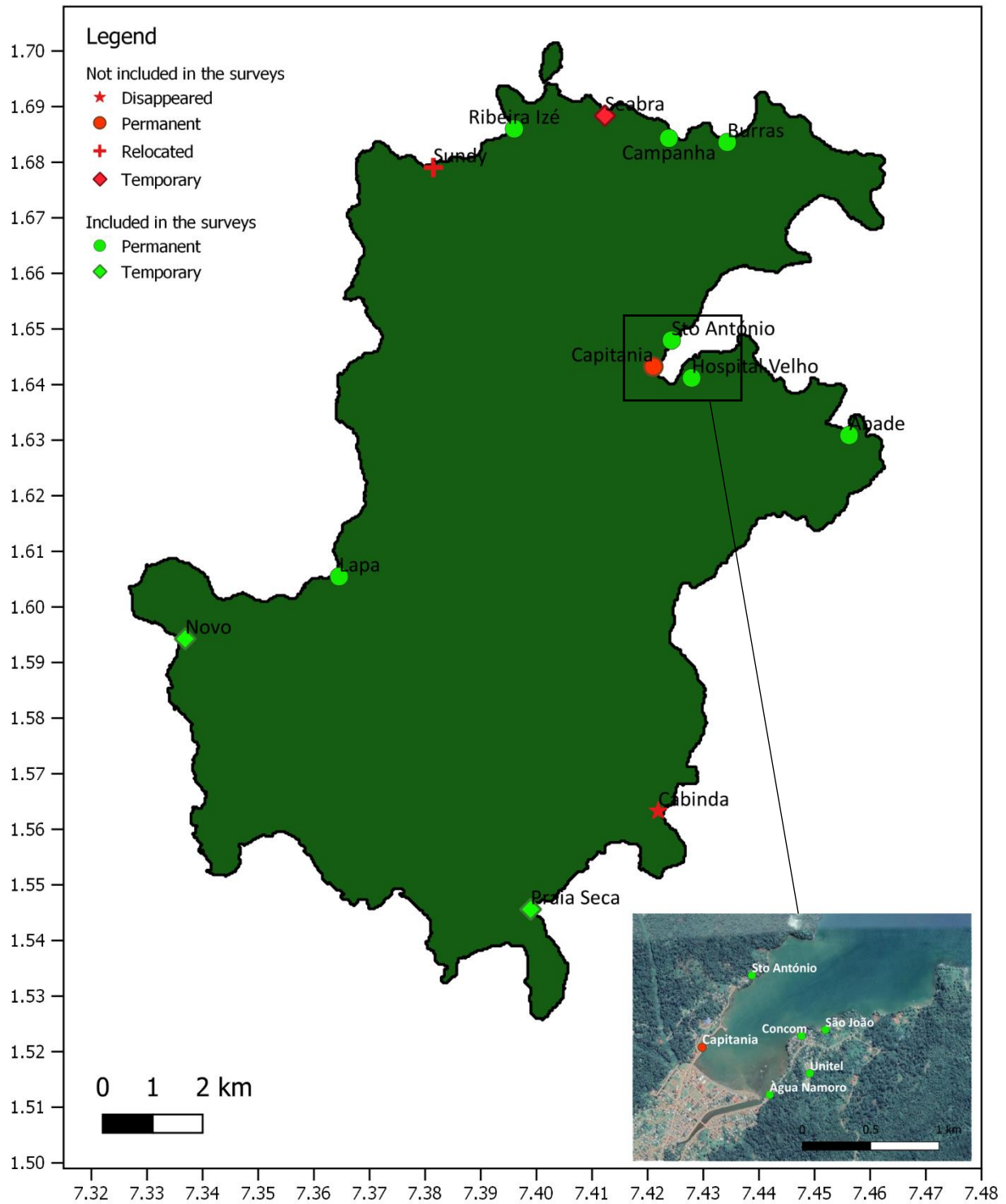


Figure 1: Fishing communities in Príncipe Island. Note that Hospital Velho is divided in four communities or “neighbourhoods”: São João, Concom, Unitel, and Água Namoro.

Landing surveys in São Tomé and Príncipe
SCIENTIFIC REPORT

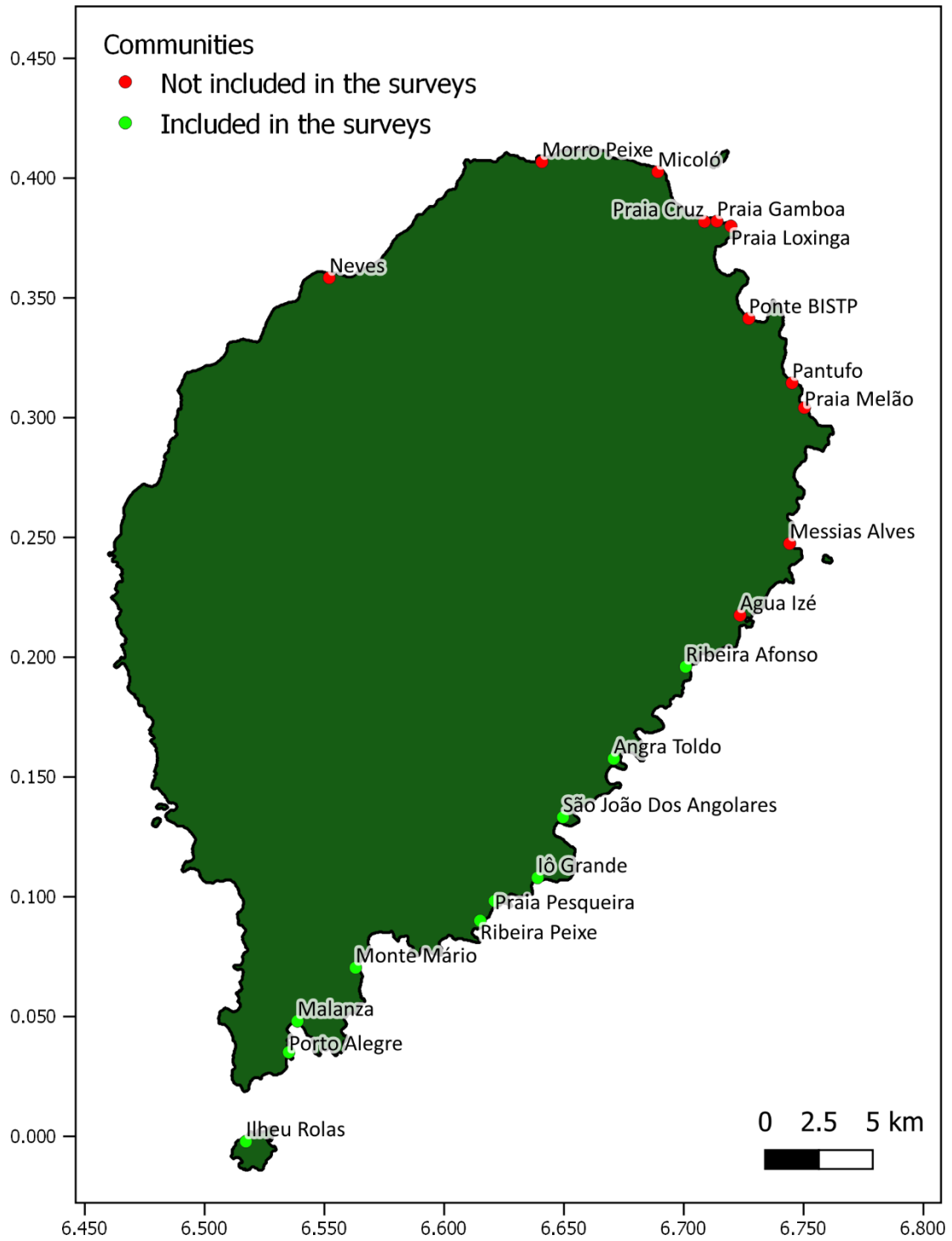


Figure 2: Fishing communities in São Tomé

Rapid assessment of fishing gears and fished species

A rapid assessment of fishing gears (including fishing boats types) and fish species was conducted by Guillermo Porriños in Príncipe (June 2019) and São Tomé (August 2019). A parallel characterisation of fishing gears was done by Litoney Matos and Manuel da Graça (*Fundação Príncipe*) between June and August 2019, conducting semi-structured interviews in all communities of Príncipe island (see Matos and Da Graça, 2019, internal report). A characterisation of São Tomé's active fisheries was conducted by MARAPA in 2017 (see Santos *et al.* 2017). The description of fishing gears and techniques included in this report includes data from these three sources. The description of the socio-economic dynamics of the landings are personal observations by Guillermo Porriños (landing and market surveys, 2017-2019).

In Príncipe, nine semi-structured interviews were conducted, targeting experienced fishers from the communities of *Ribeira Izé, Abade, Burras* and *Campanha* (June 2019). Fishers were invited to describe the different gears and techniques they knew and used, and the techniques and the gear were drawn. An initial list of fished species and their vernacular names for Príncipe was built after the landing surveys of the project *Omali Vida Nón* (see Nuno *et al.*, 2019) and the report by Tous (2015). The list was periodically updated by *Fundação Príncipe's* team (including extension workers).

In São Tomé, five Focus Groups Discussions (FGD) were held with the extension workers and with fishers from the communities of *Ilheu Rolas, Porto Alegre, Malanza* and *Monte Mário* (August 2019). A slide show with 11 fishing gears and techniques and 100 fish species were displayed, and the fishers were invited to provide the local names of each of them.

Training and recruitment of the interviewers

Landing data is being collected by extension workers -fishers or fish traders from each of the 20 communities- who were recruited by the project. Recruitment in Príncipe was led by Litoney Matos and Manuel da Graça (*Fundação Príncipe*) and in São Tomé by Albertino Santos (MARAPA) and Lodney Nazaré (Oikos). In **Príncipe**, the position was publicly advertised at the communities, and the applicants were selected by assessing the following criteria during the interview: capacity to read and write, knowledge of species and fishing gears and respectability of the applicant at the community. In total, 19 people applied, of which 7 were women; and 10 extension workers (fishers and fish traders) were recruited, of whom 3 are women. In **São Tomé**, recruitment was conducted by meeting with fishers at the community to explain the activity and asking them to choose someone. Ten extension workers were recruited, all men, of whom 7 were fishers themselves and 3 were sons of fishers.

Training was delivered over three months (July 2019 to September 2019). In total, 64 hours of training were delivered in Príncipe and 75 hours in São Tomé. During the training, the trainees interviewed the trainers, who represented increasingly complex landing scenarios. In São Tomé, the progress of the extension workers was measured using a score of 1-3 and the criteria defined in Annex IV. In Príncipe, the training was followed up by weekly visits of Manuel da Graça, to support their work and provide feedback. In São Tomé, training was followed up by visits every two weeks by Albertino Santos and Sinaida Espírito Santo (MARAPA).

Landing surveys

A smartphone-based protocol for collecting landing data was developed from June to September 2019 by Guillermo Porriños, in collaboration with Manuel da Graça (Lindo) and Litoney Matos (*Fundação Príncipe*) and a team of 20 extension workers, who tested different methods and provided feedback. Questionnaires were designed after the results of the participatory fisheries assessments. Data is collected using the open-source, smartphone application *Open Data Kit*, which uses *Extensible Markup Language* (XML) questionnaire files. The XML questionnaire files were designed in a spreadsheet software (see Open Data Kit, 2019 for detailed instructions) and converted into an *xml* file using an [online converter](#).

Landing surveys in São Tomé and Príncipe
SCIENTIFIC REPORT



Figure 3: A) Lindo conducting a test during the recruitment process; B) Full-day training of the extension workers at the fisheries department in São Tomé. C) Litoney (centre of the picture) and Lindo (right) supporting the extension workers during the training to conduct an interview; D) Extension workers of Malanza and Porto Alegre explaining the activity to the fishers (see *Consent and confidentiality*, page 10). Pictures by: Litoney Matos, *Fundação Príncipe* (A); Lodney Nazaré, *Oikos* (B); Guillermo Porriños (C and D).

Landing surveys in São Tomé and Príncipe SCIENTIFIC REPORT

The protocol for data collection is based and expanded from the landing surveys protocol of the project Omali Vida Nón (Príncipe Island, 2016-2019; see Nuno *et al.*, 2019). Data is collected twice a week (Tuesdays and Fridays) and two types of questionnaires are used: a questionnaire for recording the daily number of vessels and a questionnaire for interviewing fishers and recording landing data.

Questionnaire 1: number of vessels leaving the port on the sampling day

Each sampling day, extension workers are required to record whether they were able to work that day or not and specify the reasons if they were not. The number of vessels, disaggregated by activity type, are recorded through this questionnaire each of the sampling days. The categories for fishing activities are: 1) drifting surface gillnet; 2) set demersal gillnet; 3) purse seine net; 4) seine surface gillnet (only in São Tomé); 5) line fishing (any kind); 6) spear fishers; 7) handline fishers from land.

Questionnaire 2: landing data

See Figure 4, Figure 5, Figure 6. The sequence of questions was adapted to the dynamics of the landings, in order to minimise the disturbance to the fishers and the fish traders. The questionnaires are comprised of 277 questions in Príncipe and 303 questions (São Tomé), most of which are repeated questions for the same variables (only shown when relevant) or questions only meant to facilitate the flow of the interview and the data collection. The landing questionnaire collects information on:

- 1) General information of the fishing trip (21 variables): including fishing community, landing and departure time and date and fuel expenditure and price. Number and names of the fishers on the vessel are also recorded, and the names are chosen from a list of all fishers, filtered by community. The fishing ground is written down rather than chosen from a list, due to the high number of areas used by the fishers.
- 2) Catch (6 variables): Total weight and number of individuals of each species are recorded. The use(s) given to each species is selected from a list (consumption, selling, bait...). The price (in *dobras*, DOB) and the unit used to sell the fish (per kg or *n* fishes) are recorded only if relevant. Species are chosen from a list of 130 species (see Annex III), with the option of writing down the name if the species is not in the list. To overcome the problem of different species having the same vernacular names, species are selected using an image, and a filtered by the species' name (see Figure 5A). Different spelling options were considered to facilitate the search (for example, "*fulu fulu*" can also be spelled "*fulufulu*", "*fulu fulo*", etc.). To facilitate the data collection, the names of all the species caught by the fisher are recorded first and the information for each species is recorded afterwards.
- 3) Picture of the indicator species: for 72 species ("indicator species", see Annex III), a picture is also taken. For each of the indicator species, an orthogonal picture of at least 9 individuals is taken, placing a A3 sheet with a standard reference for size (available [here](#)) under or by the fish, which allows to measure the individual length of each fish (see Figure 7). The indicator species were selected using the following criteria: a) their global or local importance for fisheries, biodiversity and conservation (for example, species categorised as "near threatened" or "vulnerable" by the IUCN); b) species often misidentified by the extension workers; c) species with no photographic records for the country; d) species that are representative of different habitats (namely, deep demersal, demersal and big-sized epipelagic fish)
- 4) Gear used and effort (11 variables): it collects information on techniques and gears used, starting and ending times of fishing with each technique, number of sets, number of lines and hooks, length (metres) and depth (number of mesh cells) of the net, hook or mesh sizes and species caught with each technique (see Figure 6). For selecting the technique, the local names and a schematic representation of each gear is used. This information is collected at the end of the survey, and generally when the fishers have sold all the fish and walking home.

Landing surveys in São Tomé and Príncipe
SCIENTIFIC REPORT

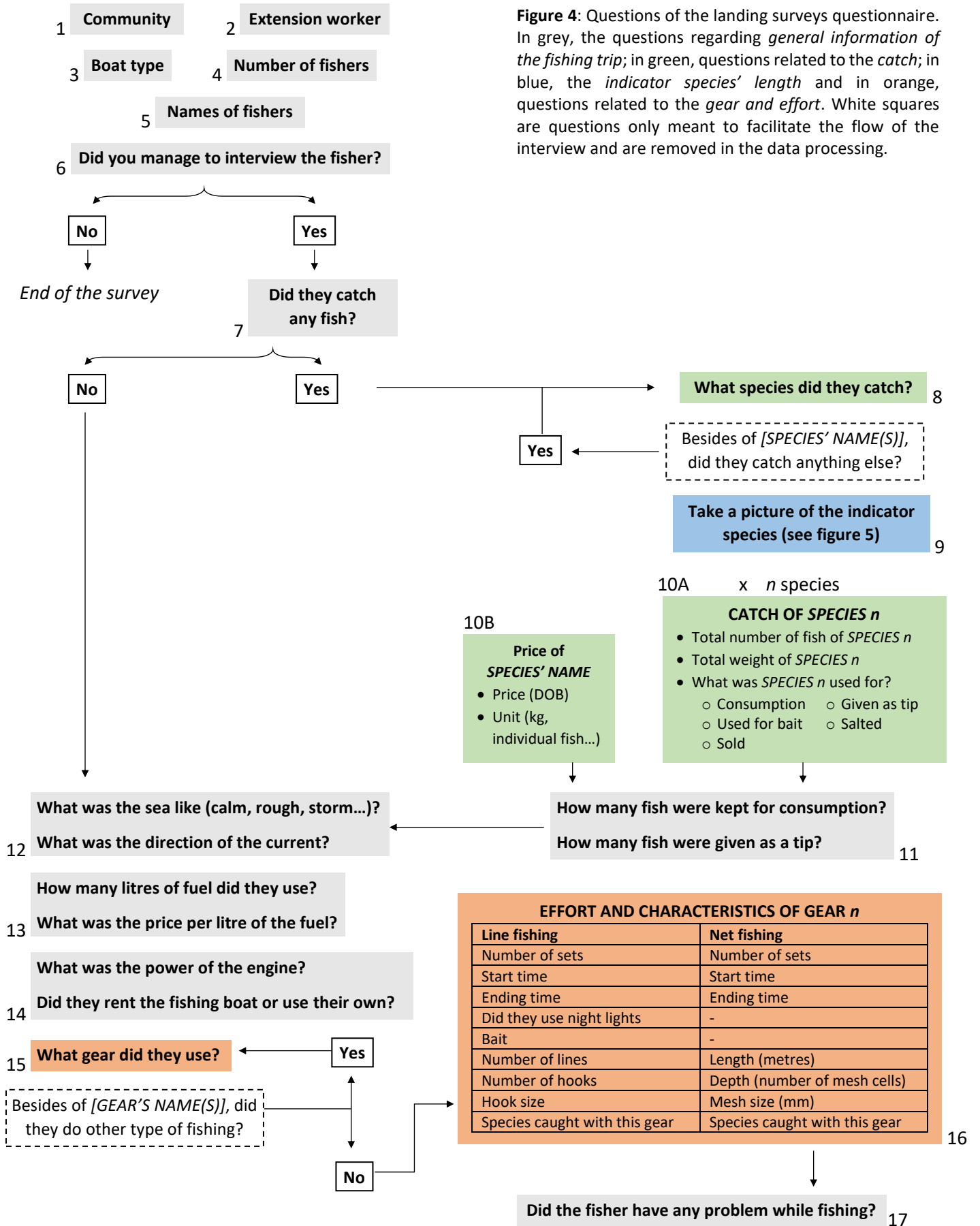


Figure 4: Questions of the landing surveys questionnaire. In grey, the questions regarding *general information of the fishing trip*; in green, questions related to the *catch*; in blue, the *indicator species' length* and in orange, questions related to the *gear and effort*. White squares are questions only meant to facilitate the flow of the interview and are removed in the data processing.

Landing surveys in São Tomé and Príncipe
SCIENTIFIC REPORT

A

DADOS DE PESCA

Capturas > Que espécies apanhou?

* Marcar tipo de peixe

Asn

Asno / Asno de fundo

Asno lamina

Asno cota

Asno mambo

< BACK PRÓXIMO >

As Asn Asneira

1 2 3 4 5 6 7 8 9 0
q w e r t y u i o p
@ # & * - + = ()
a s d f g h j k l
↑ _ z x c v b n m
123 ☺ SwiftKey !? ↵

B

DADOS DE PESCA

Capturas > ASNO-FUNDO

ASNO-FUNDO

Asno / Asno de fundo

Quantos kilos de ASNO-FUNDO?

5.400

Numero de peixes ASNO-FUNDO?

10

Comeu, vendeu e/ou usou para isco?

Tirou para comer

Vendeu

Usou para fazer isco

< BACK PRÓXIMO >

C

DADOS DE PESCA

Capturas > PREÇO DE ASNO-FUNDO

PREÇO DE ASNO-FUNDO

Asno / Asno de fundo

Preço de ASNO-FUNDO?

40

Este preço é por:

preço por kilogramo

preço por 1 peixes

preço por 2 peixes

preço por 3 peixes

preço por 4 peixes

preço por 5 peixes

preço por 6 peixes

preço por 7 peixes

preço por 8 peixes

preço por 9 peixes

preço por 10 peixes

< BACK PRÓXIMO >

Figure 5: Screenshots of the landing surveys questionnaire: A) Filter used to find the species; B) and C) Questions to record information on catch, its use and the price.


Landing surveys in São Tomé and Príncipe
SCIENTIFIC REPORT

A

Dados de pesca

Artes de pesca > Corico > Corico | A

Corico de fio grosso



Quantas mãos de corico?

2

Horas que começou pescar com corico

Selecionar hora

07:00

Hora que parou de pescar com corico

Selecionar hora

08:00


< BACK PRÓXIMO >

B

Dados de pesca

Artes de pesca > Corico > Corico | B

Corico de fio grosso



Tipo de isco que usou

Por exemplo, fulu fulu, voador, maxipombo...

Quantos fios de corico?

Quantos anzóis de corico?

Qual é o tamanho do anzol?

Selecionar uma resposta

Usou algum outro tamanho de anzol?

Marcar resto de tamanhos:

Não

Brindado

1

2


< BACK PRÓXIMO >

C

Dados de pesca


Artes de pesca > Corico > Corico | C

Corico de fio grosso




* Marcar TODAS as espécies que apanhou com CORICO de FIO GROSSO


NÃO APANHOU




Asno / Asno de fundo




Concom



Corvina de caça



Fulu fulu batido / karaté



Tubarão martelo / totô

< BACK PRÓXIMO >

Figure 6: Screenshots of the landing survey questionnaire: **A)** Time that the fisher started and finished fishing; **B)** Information on the gear used; **C)** What species were caught with the gear.

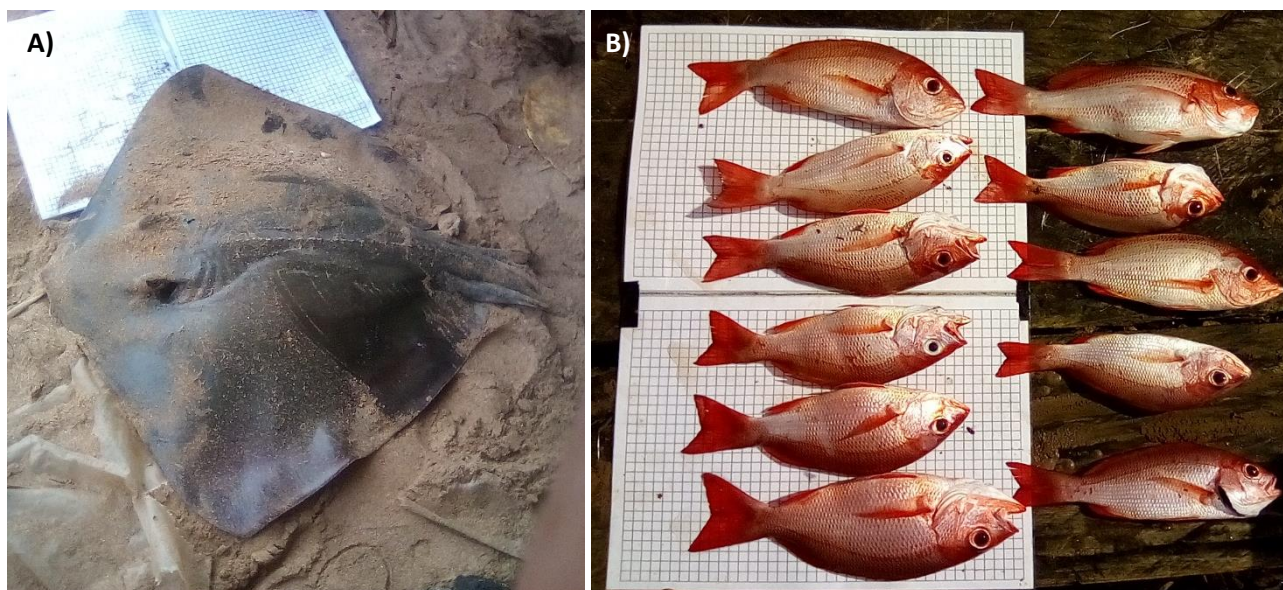


Figure 7: Examples of pictures of the indicator species collected by the extension workers. A single picture per indicator species is taken, covering at least 9 individuals in the picture (if available). Each of the cells of the grid used as a reference for size is 11 mm. The species are **A)** *Dasyatis* sp. and **B)** *Lutjanus fulgens*.

Extension workers are asked to interview *at least* 6 fishers per day and distribute their sampling effort to collect information on all the fishing activities. A survey for a trip with two or three gears and several species takes 20 to 30 minutes to complete. For the rest of the landings, the extension workers are asked to collect information on the landing time, vessel type and number and names of the fishers (steps 1 to 5 of the Figure 4), and select “*I did not manage to interview the fisher*” (step 6 of the Figure 4).

Consent and confidentiality

Two levels of consent were obtained. Meetings were held before the landing surveys started in all the communities. The activity and its purpose were explained, as well as the protocol for ensuring the confidentiality of the data (see Figure 3A). Fishers who were willing to participate were invited to provide their names to put them as choices in the questionnaires (nickname and, if willing, full name), explaining that an individual code would be assigned to each fisher to ensure the confidentiality of the data. For each enquiry, the activity is explained, and the fisher is verbally asked for consent. Only the codes -not the names- are recorded in the database, and the correspondence between the codes and the identity of the respondents is kept confidential.

Cleaning and assessment of the data quality

The raw data is sent bi-monthly to four online spreadsheets (one for each of the two questionnaires types and for each island), stored in a *google drive* account. Data is copied from the online spreadsheets into two spreadsheet workbooks using the commercial spreadsheet software *Microsoft Excel*, which automatically create new data frames by removing the non-meaningful variables and reorganising the landing data (questionnaire 2) into three data frames (general information, catch and effort, see Annex VIII). The pictures of the indicator species are labelled with the trip code and the species’ name.

Data is cleaned bi-monthly, immediately after the data is sent to the drive. Each instance is cleaned and verified manually, and given a score using the 25 criteria described in Annex V to calculate the percentage of data properly corrected. For each extension worker, the most common mistakes committed are compiled into a document and returned to them for feedback. Low-quality instances are tagged to be later removed in the analysis.

**Landing surveys in São Tomé and Príncipe
SCIENTIFIC REPORT**

Some species are caught in high numbers and sold by fish or by *n* fishes, making it difficult for extension workers to collect weight information. For these species, when the total weight information is missing, it is calculated from average weights collected by the extension workers in the field (see Table 1).

Table 1: Average weights of species sold by number of fish, and frequently not weighed by the extension workers. All the fish of each species coming from a single fishing trip were weighed together.

Species	Average weight	n fish	n trips
<i>Dactylopterus volitans</i> (flying gurnard, “concom”)	296 g	280	11
Exocoetidae (flying fish, “peixe voador”) caught by drifting surface gillnet	378 g	1290	6
<i>Hemiramphus balao</i> (Balao halfbeak, “maxipombo”)	133 g	1650	4
<i>Balistes carolinensis</i> (grey triggerfish, “asno de fundo”)	491 g	60	6
<i>Ablennes hians</i> (flat needlefish, “agulha espada”)	437 g	20	3
<i>Tylosaurus spp</i> (hound and agujon needlefish, “agulha quiô”)	381 g	76	11

Data analysis

Data was analysed using commercial spreadsheet software and R. Individual lengths of indicator species are measured using the scaled pictures taken by the extension workers and the software *ImageJ* (the pictures have not been analysed yet).

Catch-Per-Unit-Effort (CPUE) has been calculated using the units described in Table 2, modified from FAO’s guidelines for collecting fisheries data (FAO, 2004). Since several gears are often used during the same trip, it is also recorded which species were caught with each gear. If one species is caught with two or more different gears during the same trip, the data is automatically tagged and removed from the analysis to avoid overestimating the total weight of the catch.

The net profit of each trip is calculated by subtracting the fuel expenditure to the revenues of selling the fish (the value zero is allocated to the price of the species not sold or kept for consumption). If they are renting the gear (boat, engine and net), this value is divided by two (half for the owner and half for the fishers). The rest is divided by the number of fishers on the boat.

Table 2: Catch Per Unit Effort units of the main categories of fishing gears in Príncipe, adapted on recommendations from fisheries monitoring by FAO (2004).

GEAR	Units
Gillnet	Kg / 100 metres of net * hour
Purse seine	Kg / set
Handline (less than 20 hooks)	Kg / line * hour
Longline (more than 100 hooks)	Kg / 100 hooks * hour
Spear fishing	Kg per hour

RESULTS

Data from Príncipe comes from the communities of Abade, São João, Unitel, Concom, Água Namoro, Santo António, Burras, Campanha, Ribeira Izé and Lapa. In total, 424 trips have been recorded from August 1, 2019 to November 12, 2019; and only 377 surveys contain information on catch and effort, the rest coming from fishers who did not will to participate in the survey. By December 3, 2019 a total of 1007 interviews had been conducted in Príncipe island (this data has not been analysed yet). Information on the daily number of fishing trips (questionnaire 1) is only available for 18 sampling days (October 2019 to December 2019)

Landing surveys in São Tomé and Príncipe SCIENTIFIC REPORT

Data from São Tomé comes from the communities of Ilheu Rolas, Porto Alegre, Malanza, Monte Mário, Ribeira Peixe, Iô Grande, Angra Toldo and Ribeira Afonso. Data was recorded from September 15, 2019 to November 18, 2019. Data from the communities of Praia Pesqueira and Angolares were dropped due to low data quality. In total, 268 trips were recorded, but only 225 were used after removing low-quality data. Of these 225 trips, only 162 surveys contain information on effort and catch, the rest coming from fishers who did not will to participate in the survey. Information on the daily number of fishing trips in São Tomé exists, but is not available yet.

Assessment of training and data quality

By the end of the training, all the extension workers in Príncipe were able to conduct the work independently. In São Tomé, all the extension workers improved the quality of the data collection by at least one point, on a scale of 0 to 3. Two extension workers in São Tomé were not able to complete the training successfully and were later dismissed. They reported difficulties on using the tablet and/or reading the questions.

Both in Príncipe and São Tomé, all the extension workers managed to collect at least 70% of the data correctly, excepting two extension workers in São Tomé (see Annex VI and Annex VII). The lowest scores appear on the pictures of the indicator species, and the most common mistakes were not using a reference for size, only taking a picture of one fish of the indicator species or taking the picture at a very low angle. Several extension workers also reported difficulties interpreting the question of the unit of the price (per kilogram or per n fish). Most common mistakes were related to skipping questions, which were significantly reduced after making most questions compulsory. It is often common that the wrong line fishing gear or net fishing gear is selected, which is related to fishers using slightly different terms to refer to the same gear.

Socio-economic dynamics of the landings

In São Tomé and Príncipe, the dynamics of the transactions in the landings vary depending on the type of fishing and the location. The boats are frequently kept out of the water, at least at 7 to 10 metres from the water line. When the boats arrive, the people at the landing site will help the fisher pushing the canoe out of the water and, if the catch has been good, they will get one or two small fish for their help (this practice is called “*São Pedro*”).

In many cases, the fish is sold directly at the landing site to a *palaiê* (fish traders, normally women), who will bring a weighing scale -if available- and will sell some of the fish directly at the fishing boat, taking the rest to the market. In many other cases, the *palaiês* might also keep the fish for drying or salting, as it happens with the flying fish. The *palaiês* generally take care of all the transactions and get a net profit of 10 dobras per kilo of fish (0.41€). The fishers sell the fish to the *palaiês* at 40-70 dobras per kilo (2 to 3€), depending on the abundance of fish and the cost of the fuel.

Artisanal fishing boats

Vessels in Príncipe can be divided into three main types: dugout, “Prao” and canoe. **Dugout fishing boats** are made of one piece of solid wood. Length of engine-propelled dugouts was reported to be 7 to 9 metres and can bear engines of up to 15 and 25cv. Smaller dugouts (4-5 metres) cannot bear engines due to their higher instability and are propelled by rowing or sailing. Fishers reported not using sail dugouts very often in Príncipe because the winds are not favourable to return to the island. “**Prao**” fishing boats are often made of fibreglass or laminated wood panels and have a smaller side hull attached to the main hull to provide stability. They are reported to be 5 to 7 metre-long and can bear engines of 15 to 25cv due to their higher stability. They can also be propelled by sailing or rowing. Wooden dugout rows can also be built, by attaching a smaller dugout hull to a main ~5-metre-long dugout hull. **Fibre-glass canoes** are approximately 10 metre-long and 1.5 metre wide. In Príncipe (n=424 fishing trips), dugouts are the most used vessel type (77%), followed by praos (13%) and fibre-glass canoes (8%). Small rowing dugouts are used in 26% of the fishing trips.

Landing surveys in São Tomé and Príncipe SCIENTIFIC REPORT

Boats can be owned by the fishers themselves or rented to someone else. If the fishers are renting the boat, they are often referred to as “sailors”, and they must give half of their catch or profit to the owner of the canoe. In Príncipe (n=424 fishing trips), 48% of the respondents were using their own material. Sixty percent of fishers using their own vessels had an engine-propelled boat, with 39% using small rowing dugouts. Only 8% of the respondents who were using a rented boat were using the latter.

Fishing gears and techniques

Monitoring artisanal fisheries in São Tomé and Príncipe is challenged by the variety of fishing techniques and gears. In addition, limits between techniques and gears are not often clear, which hinders subdividing them into categories that are comparable. The main and more widely practised types of fishing in Príncipe are net fishing (Table 3), line fishing (Table 4) and spear fishing (Table 5). Other specialised techniques (Table 5), which are only practised seasonally and/or only in certain regions include: traps for spider crabs, seine fishing for small fish at the river mouths and “*pesca de voador-panhá*”, fishing for small-sized flying fish using a racket.

Line fishing gears have been subdivided in handline (less than 25 hooks) and longline (over 100 hooks). Only five records of demersal longline had between 50 and 70 hooks. Hook sizes are referred to by a numbering system in which 1 is the biggest size, and larger hooks are represented by smaller hook number (the smallest hook size reported in São Tomé and Príncipe is 22). “*Brindado*” can also be used for catching sailfish and blue marlin instead of a hook; a device made of thick plastic threads, around 40cm long that get entangled around the beak of the fish. The main line of the fishing gear is called *barriga de fio* (the “belly of the line”), which can have different thickness depending on the fishing type. Shorter, and generally thinner lines bearing the hooks are attached to the main line (“*mama*” or “*costumado*”). Weights of different sizes are attached to the main line to sink it or anchor it to the bottom. They can be attached at the end of the line (to keep it vertical) or before the hooks (to keep the part of the line bearing the hooks in a horizontal position). The weights can be *chumbos* (leads), made by breaking down engines or other sources of metal; or stones of different sizes, wrapped around a net and attached to the main line. Bait can be fish (sliced or alive), octopus, crabs or artificial bait. In Príncipe, main species used for bait are flying fish (45.7%), “*fulu fulu*” (small tuna of the species *Euthynnus aletterattus* and *Auxis thazard*, 27.5%), *Sardinella* sp. (6.7%), octopus (5.4%) and *Hemiramphus balao* (5.4%). Artificial bait can be *palha* (“straw”), squid-shaped fishing lures, made with small plastic threads tied around the hook, mimicking the tentacles of a squid or octopus; and fish-shaped hooks, made with a small, fish-shaped sheet of plastic with a metallic shine, normally made out of 5-litre wine bags. In Príncipe, 57% of the line fishing records used squid-shaped fishing lures. The main types of line fishing have been subdivided in 1) jigging handline, a handline with 3-20 hooks and with a weight at the end of the line to keep it vertical; 2) demersal set handlines or longlines, which use baited hooks and are kept in parallel to the bottom by one or several anchors located along the line; and 3) troll, consisting on dragging a line with 1 to 300 hooks (with fish or artificial bait) at the surface or mid-water level or close to the bottom, which can have a weight before the hooks to sink the line but keep it horizontal. There are three main types of **net fishing**: 1) gillnetting, a passive method consisting on leaving a net at surface or bottom level where the fish will get trapped; 2) purse seine, consisting on actively targeting shoals of fish and surrounding them with a deep net, which is closed from the bottom with the seine cable; and 3) seine surface gillnet, in which epipelagic fish are pushed towards a surface gillnet by dragging a long seine cable on the surface. Nets panels are normally kept in a vertical position by small buoys (generally made by old flip-flops) attached to the upper edge and small leads attached to the lower edge. **Submarine hunt** (“*caça submarina*”), is the third main type of fishing, which is done by free divers using a spear or an iron rod. Divers are not considered fishers and are referred to as “*submarinos*”.

**Landing surveys in São Tomé and Príncipe
SCIENTIFIC REPORT**

Table 3: Types of net fishing in São Tomé and Príncipe

Gear	Description
<p>Set demersal gillnet <u>Effort units:</u> kg per 100m per hour</p>	<p>Set gillnet, with a length of 100-300 metres. The net is anchored at the bottom, normally with two small rocks wrapped in a piece of net and attached at each end of the net and kept in vertical position with small floaters or buoys attached to the upper edge, and small weights attached to the lower edge of the net. The net is generally deployed at night-time (17:00 to 00:00) and retrieved in the morning. Catch is generally composed of medium-sized fish (35-70 cm) that get entangled or welded (wrapped by the net) as the pass through (pers. observation). Small sharks (40-70 cm) are often caught with this gear (pers. observation), and turtles get often trapped in the nets when they try to reach the beach in the brooding period (Sara Vieira, pers. communication).</p> <p><u>Local names:</u> <i>rede feijão</i> (São Tomé) or <i>rede malhadeira</i> (Príncipe).</p>
<p>Drifting surface gillnet <u>Effort units:</u> kg per 100m per hour</p>	<p>Its size varies from 800 to 2600 metre-long and 2 to 3 metre-deep. The mesh size varies from 55 to 70 mm. It is kept in vertical position by small buoys on the upper edge and small weights attached to the lower edge. The net is generally painted in dark red to make it less noticeable. The net is released at night-time, immediately after sunset (approximately 17:00) and it is retrieved one hour after the net was deployed entirely. This type of fishing is normally done by two fishers: when one fisher deploys the net, the other moves the boat against the current to stretch the net; and when one fisher pulls the net into the boat, the other moves the boat towards the net to facilitate. Fish are caught by gilling: the fish slips within the mesh behind the opercula. The main component of the catch is flying fish of the family Exocoetidae (78%), followed by the flat needlefish, <i>Ablennes hians</i> (21%).</p> <p><u>Local names:</u> <i>Rede voador</i> (flying-fish netting). In São Tomé can also be called “<i>ximple</i>”, when it is practised close to the departing site, or “<i>gonga</i>”, when it is practised far from it.</p>
<p>Purse seine <u>Effort units:</u> kg per set</p>	<p>Type of fishing done in groups of 4-6 fishers using a deep net of 100 – 800 metre-long, with buoys on the upper edge and weights on the lower edge. The net is released encircling a shoal and it is closed in the bottom using seine line (<i>cabo de brisa</i>). The main component of the catch in Príncipe is “maxipombo” (<i>Hemiramphus balao</i>), although many other species are captured, such as <i>fulu fulu</i>. No data is available for São Tomé within the Blue Action dataset. This type of fishing is highly destructive when done close to the shore, as it catches many juveniles of demersal fish such as snappers and groupers.</p> <p><u>Local names:</u> <i>rede maxipombo</i> (net for West-African halfbeak, only in Príncipe); <i>rede cerco</i> (surrounding net); <i>rede brisa</i> (seine net); <i>rede de mil malhas</i> (net of a thousand cells).</p>
<p>Surface seine gillnet <u>Effort units:</u> kg per set</p>	<p>This technique is only used in São Tomé. For this type of fishing, a drifting surface gillnet is deployed. A seine cable of up to 2 km-long is attached to one of the ends of the net and released afterwards. Once the seine cable has been stretched, the vessel moves fast towards the other end of the net, closing the circle. The seine cable is dragged on the surface of the water, creating noise and turbulence that pushes the fish against the net.</p> <p><u>Local names:</u> <i>rede brisa</i>, <i>rede brisa de voador</i>.</p>

Landing surveys in São Tomé and Príncipe
SCIENTIFIC REPORT

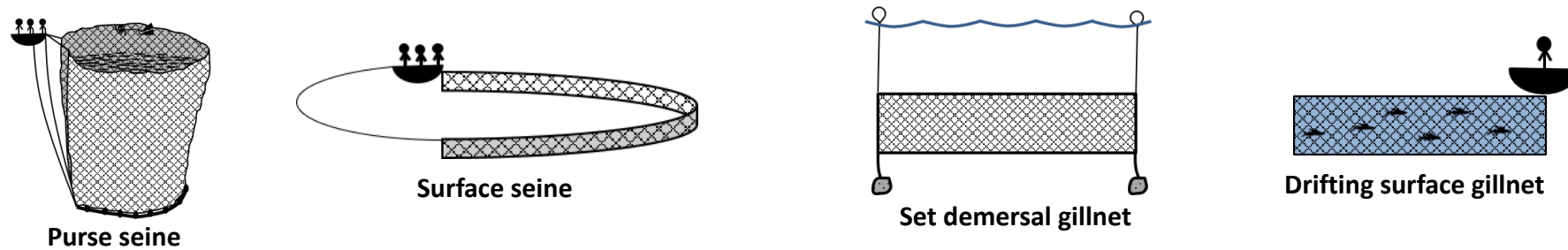


Figure 8: types of net fishing in São Tomé and Príncipe (© Guillermo Porriños)

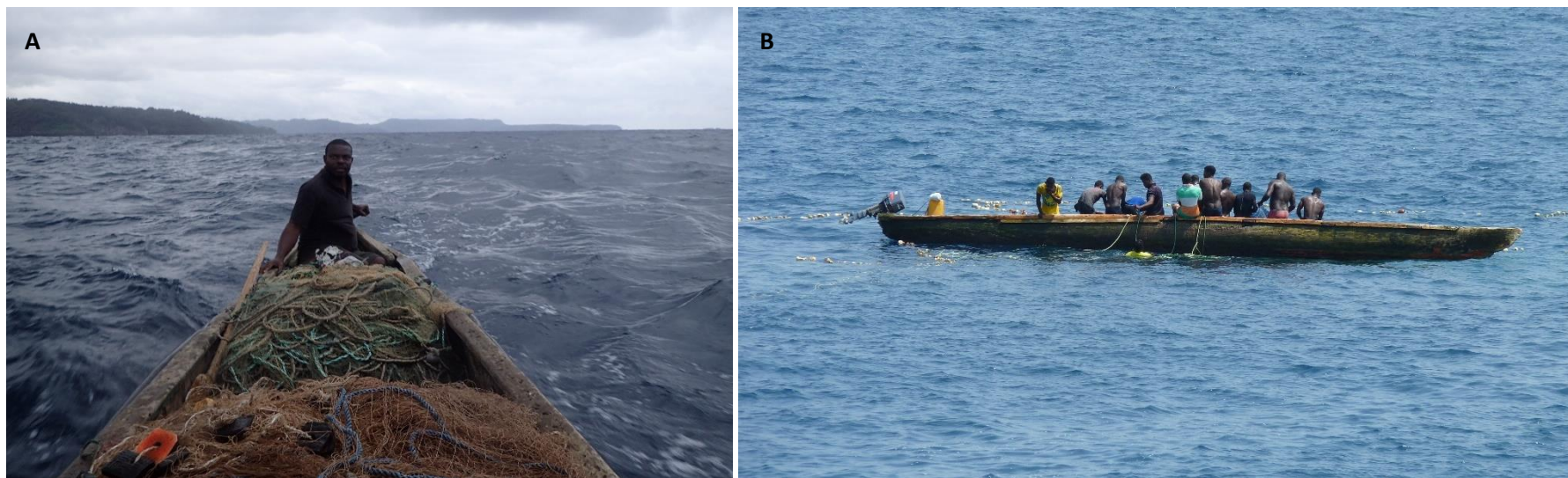


Figure 9: A) Fisher from Abade (Príncipe) going drifting-gillnet fishing; B) Purse seine fishing in São Tomé. Pictures by Guillermo Porriños.

Landing surveys in São Tomé and Príncipe
SCIENTIFIC REPORT

Table 4: Description of gears and techniques used for line fishing in São Tomé and Príncipe.

Gear	Description
JIGGING HANDLINE: handline with a weight at the end of the line to keep it vertical. It is generally jigged, although when fish-bait is used, it can be kept still.	
Jigging handline with squid-shaped fishing lures <u>Effort units:</u> Kg per h per line	<p>Subcategory A: It always uses artificial bait made with short plastic threads (“<i>palha</i>”) tied around the hook imitating a small squid or octopus, and the line is constantly jigged. It uses 6-15 hooks, normally of sizes 9-12. The main component of the catch is blue runner (<i>Caranx crysos</i>); <i>Lutjanus fulgens</i>, a small-sized snapper species; <i>fulu fulu</i> (small tunas of the species <i>Euthynus alleteratus</i> and <i>Auxis thazard</i>); amongst others. This type of fishing is generally done at night (midnight to 5 or 6AM)</p> <p><u>Local names:</u> <i>toca-puxa</i> (touch and pull) or <i>toca</i> (“touch [the seafloor]”). The name <i>pingué</i> is also used in Príncipe.</p>
	<p>Subcategory B: The abovementioned technique is the most common variation of this type of gear. In São Tomé, a specialised variation of this type of fishing is also used to catch bait fish (<i>personal observation</i>). For example, in the community of Ribeira Afonso and Angolares, fishers have been observed to leave at afternoon time or daytime to catch bait fish, mostly of the genus <i>Sardinella</i>, using a handline with smaller hooks (size 17 to 20). In Príncipe, a jigging handline with artificial bait can also be used during the daytime, generally during the afternoon, although it was not reported to target bait fish exclusively (see Matos and Da Graça, 2019). In this case, the handline uses hooks of size 15 to 17 and this type of fishing can also be called “<i>pingué</i>”.</p> <p><u>Local names:</u> generally known as <i>toca</i>, although the name “<i>pingué</i>” can also be used in Príncipe. Note that the name “<i>pingué</i>” in São Tomé is also used to refer to a type of handline with a weight before the hooks, generally used for surface or mid-water troll.</p>
Jigging handline with baited hooks <u>Effort units:</u> kg per line per hour <i>*Note that major variations regarding bait type and number and size of hooks exist for this technique. Although it can be classified into sub-categories, distinctions between them are not often clear.</i>	<p>Subcategory A: The names listed below normally refer to a handline with 4 to 13 hooks, of sizes ranging from 5 to 11. Most common baits are <i>voador</i> (flying fish), <i>fulu fulu</i> and <i>maxipombo</i> (<i>Hemiramphus balao</i>);</p> <p><u>Local names:</u> <i>fio de fundo</i> (only in São Tomé), <i>cú no chão</i> (only in Príncipe), <i>costumado</i> (both in São Tomé and Príncipe).</p>
	<p>Subcategory B: Handline with one big-sized hook, normally of size 1 to 3. The boat might be anchored, drifting or rowing slowly. It normally targets bigger fish, such as sharks, big carangids or big snappers. For sharks, the hook is not attached directly to the main line, but through a metallic line of approximately 1 metre. Bait is normally <i>fulu fulu</i>, flying fish or <i>maxipombo</i>.</p> <p><u>Local names:</u> <i>fio jogado</i> (“thrown line”) or <i>matelé</i> (in Príncipe), <i>sonda</i> (in São Tomé); <i>atravessado</i> or <i>travessado</i> (“crossed”, if the boat is drifting), <i>fio remado</i> (“rowed line”, if they are rowing). The gear is normally referred as <i>fio grosso</i> (“thick line”), which can also be used for surface trolling</p>
	<p>Subcategory C: Handline jigging in deep water using a line comprised of 6 to 12 hooks. It generally uses baited hooks and artificial bait is rarely used. This type of fishing is normally done in the morning (06:00 to 11:00) and generally only done if the other types of line fishing have not been successful or are not available due to the weather conditions. <i>Dentex macropthalmus</i>, <i>Pontinus kuhlii</i> and <i>Erythrocles monodii</i> are caught almost exclusively with this type of fishing and comprise the main component of its catch.</p> <p><u>Local names:</u> <i>fundo</i> (exclusively used in Príncipe). Although this type of fishing is practised in São Tomé, there is not a specific name for it, and therefore, landing surveys in São Tomé do not reflect the distinction of handline fishing on shallower and deeper fishing grounds.</p>

**Landing surveys in São Tomé and Príncipe
SCIENTIFIC REPORT**

Table 4 (cont): Description of gears and techniques used for line fishing in São Tomé and Príncipe.

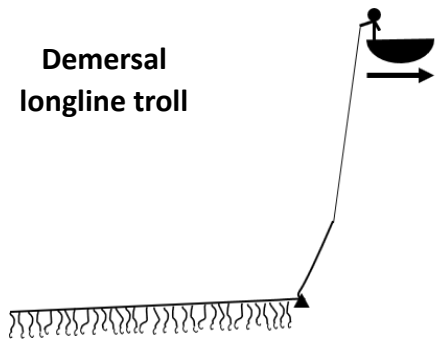
Gear	Description
<p>TROLLING TECHNIQUES: Trolling (“<i>corico</i>”) consists on dragging one or several lines at different water levels. However, the name “<i>corico</i>” is generally only used to refer to the surface and midwater handline troll, and it is rarely or never used to refer to the demersal longline troll</p>	
<p>Demersal troll <u>Effort units:</u> kg per hour per 100 hooks</p>	<p>A longline comprised of 100 to 320 hooks is dragged slowly and close to the bottom. The size of the hooks ranges from 8 to 1, and it always uses artificial bait (“<i>palha</i>”). Catch is similar to the catch of the jigging handline with artificial bait.</p> <p><u>Local names:</u> The gear is called “<i>arrastão</i>”, and the type of fishing is called “<i>pesca de arrastão</i>”.</p>
<p>Surface or mid-water handline troll <u>Effort units:</u> kg per hour per line</p> <p><i>*Note that major variations regarding bait type and number and size of hooks exist for this technique. Although it can be classified into sub-categories, distinctions between them are not often clear.</i></p>	<p>Subcategory A: a thicker handline with one big-sized hook (1 or 2)), used to catch bigger fish, such as large carangids, wahoo (<i>Acanthocybium solandri</i>), dolphinfish (genus <i>Coryphaena</i>) amongst others. Bait used is normally <i>fulu fulu</i>, which can be used live or filleted. For catching blue marlin and sailfish a specialised device called “<i>brindado</i>” can also be used, which is comprised of long and strong threads at the end of the line, which gets entangled around the fish’ beak.</p> <p><u>Local names:</u> “<i>corico</i>”, “<i>corico de fio grosso</i>” (thick-line trolling).</p>
	<p>Subcategory B: handline with several hooks with artificial bait, which can be fish-shaped (made from plastic with a metallic shine) or squid-shaped (made of “<i>palha</i>”, as previously described). It uses smaller hooks and it is used to catch “<i>fulu fulu</i>”. It can use a weight before the hooks</p> <p><u>Local names:</u> “<i>corico de fulu fulu</i>” (handline troll for fishing <i>fulu fulu</i>). In São Tomé, when it bears a weight before the hooks is called “<i>samba</i>” or “<i>pingué</i>” (only in São Tomé).</p>
	<p>Subcategory C: one or several fish-baited smaller hooks (sizes 7 to 12). It is difficult to establish a clear division between subcategories A and C, and several variations can be found within this one</p> <p><u>Local names:</u> <i>corico</i> (trolling), <i>fio de corico</i> (handline troll).</p>

**Landing surveys in São Tomé and Príncipe
SCIENTIFIC REPORT**

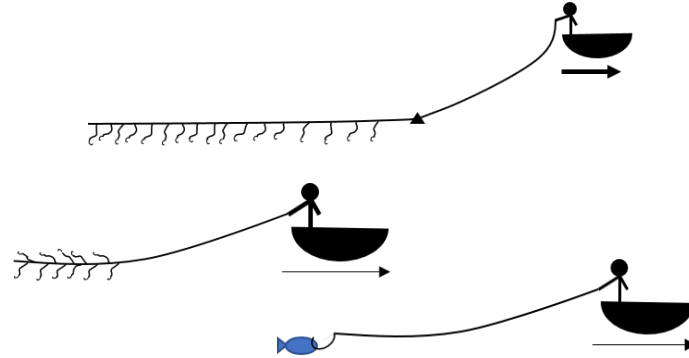
Table 4 (cont.): Description of gears and techniques used for line fishing in São Tomé and Príncipe.

Gear	Description
SET DEMERSAL LINES	
<p>Demersal handline with baited hooks <u>Effort units:</u> kg per line per hour</p>	<p>Handled manually by the fisher from the boat. Line comprised of 6-20 fish-baited hooks, with a weight in the front that keeps the line in parallel to the bottom (see figure 2). It may use a bent wooden stick (“<i>vega</i>”) attached to the first weight, which shakes the line underwater. It might have an additional weight at the end of the line (when there is no current) or just the one weight at the front when the current is strong, which allows the line to be dragged by the current, spreading the bait flume. The main component of the catch in Príncipe is bluespotted seabream (<i>Pagrus caeruleostictus</i>), followed by lutjanid snappers.</p> <p><u>Local names:</u> In Príncipe, this type of fishing is called “<i>rabo</i>” (“tail”) when it only uses the first weight, and “<i>palim</i>” when it uses two weights. In São Tomé it can be called “<i>xitô</i>”, “<i>vega</i>” or “<i>pingué de fundo</i>” (the latter when it only uses the first weight).</p>
<p>Demersal longline <u>Effort units:</u> kg per hour per 100 hooks</p>	<p>Longline comprised of 100 to 800 hooks, kept in parallel to the bottom by 2 or more anchors, each of them attached to a buoy at the surface. Fishing is done at night, normally by two fishers (one drops the gear and the other moves the boat forward to avoid the entanglement of the line). In Príncipe, the main component of the catch in terms of weight is seabreams (<i>Pagrus caeruleostictus</i>, 42%), flying gurnards (<i>Dactylopterus volitans</i>, 32%), emperors (<i>Letrhinus atlanticus</i>, 8%) and snappers (<i>Lutjanus</i> spp, 5%).</p> <p><u>Local names:</u> <i>Palanque</i>.</p>

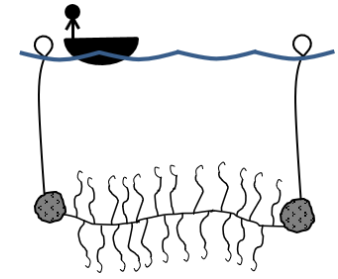
Landing surveys in São Tomé and Príncipe
SCIENTIFIC REPORT



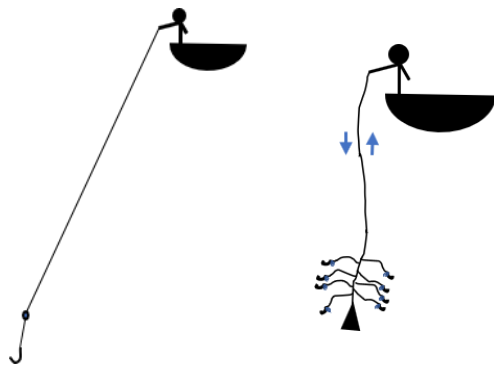
Demersal longline troll



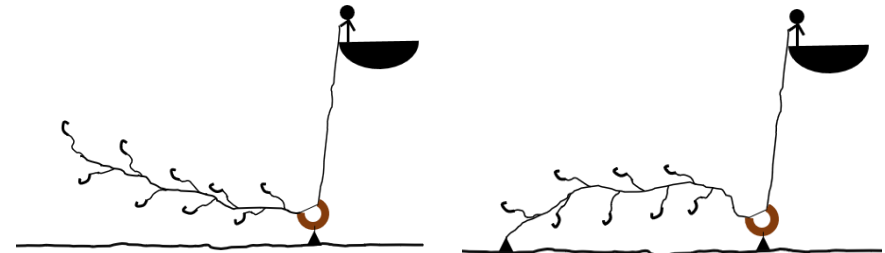
Surface and mid-water handline troll



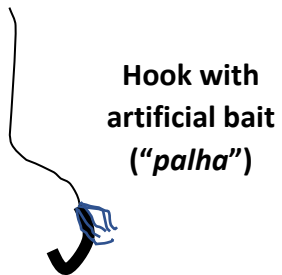
Set demersal longline



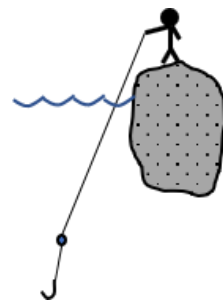
Jigging lines



Demersal handline with baited hooks



Hook with artificial bait ("palha")



Line fishing from land ("quital")

Figure 10: types of line fishing in São Tomé and Príncipe
(© Guillermo Porriños)

Landing surveys in São Tomé and Príncipe
SCIENTIFIC REPORT



Figure 11: **A)** Catch of a demersal longline troll, mainly composed of blue runner (*Caranx crysos*), fulu fulu and small specimens of *Seriola rivoliana* (almaco jack). **B)** Fisher from Hospital Velho returning after using a set demersal longline. To avoid the entanglement of the line, the hooks are nailed to a wooden table in an organised way, as shown in the picture. **C)** “Vega”, a bent wooden stick acting as a spring, which is attached to the anchor of the demersal handline and used to shake the line and spread the smell of the bait. The weight is located before the hooks, to keep the part of the line bearing the hooks in parallel to the bottom. Pictures by Guillermo Porriños.

**Landing surveys in São Tomé and Príncipe
SCIENTIFIC REPORT**

Table 5: Other types of fishing in Príncipe. Fishing types marked with an asterisk (*) are not included in the landing surveys. See Santos *et al* (2017) for a more exhaustive classification of the gears.

Gear	Description
Submarine hunt <u>Effort units:</u> kg per 100m per hour	Free divers who practise this activity are often not considered fishers, and they are referred to as “ <i>submarinos</i> ”. Octopus is one of the main components of the catch, which is generally caught with an iron rod, bent on the edge, used to hit the octopus or drag it out of its den. <i>Submarinos</i> also use spears, used to catch cuttlefish and fish such as snappers, parrotfish or groupers. Experienced <i>submarinos</i> report reaching depths of up to 30 metres.
Apanha de voador / Pesca de voador panhá <u>Effort units:</u> kg per hour	Mostly practised during <i>Gravana</i> , the dry season, from May to August. It uses a floating device with long straws soaked in cooking or palm oil with coconut. Small flying fish are attracted to eat the coconut, and the oil spreads on the water, creating a film that eliminates the ripples on the water. The fish is caught using the circular net, which is handled manually. In parallel to this, one or several handlines can also be used, using the flying fish as live bait. Only practised in São Tomé.
*Traps for spider crabs	Spider crabs (<i>Santola</i>) are caught using traps. This type of fishing is only practised in the north of São Tomé.
*Peixinho fishing	Seine fishing for small fish in river mouths, generally using a mosquito net. It is not known with certainty which species are caught.



Figure 12: A) Device used to attract the flying fish; B) Small fish caught using mosquito net; C) Diver catching octopus with an iron rod. Pictures by G. Porriños.

Effort and Catch-Per-Unit-Effort

Data on the daily number of fishing trips per community only exists for Príncipe (n= 18 sampling days, 11 permanent and temporary communities, Oct. to Dec. 2019). In Príncipe, 46% of all fishing trips are vessels going for line fishing; a third of the fishing trips correspond to fishers doing surface gillnet fishing; followed by spear fishers (13%) and purse-seine fishing trips (5%). Demersal gillnet is rarely practised (only 0.3% of the fishing trips) and line fishing from land only corresponds to 1.6% of the fishing trips. The latter is probably an underestimation of the real number, as jigline fishers who fish from the coast do not normally use the main landing sites and might not even live at the fishing communities (*personal observation*).

Table 6: contribution of the main types of fishing to the total number of fishing trips per day

	Sum of daily trips	%	Daily average	Daily sd	Daily max
Surface gillnet	210	33.5%	11.7	5.2	24
Panhá	0	0.0%	0.0	0.0	0
Purse seine	33	5.3%	1.8	1.3	5
Seine gillnet	0	0.0%	0.0	0.0	0
Demersal gillnet	2	0.3%	0.1	0.6	1
Spear fishing	80	12.8%	4.4	2.7	9
Line fishing	291	46.5%	16.2	8.3	32
Line fishing from land	10	1.6%	0.6	1.0	3

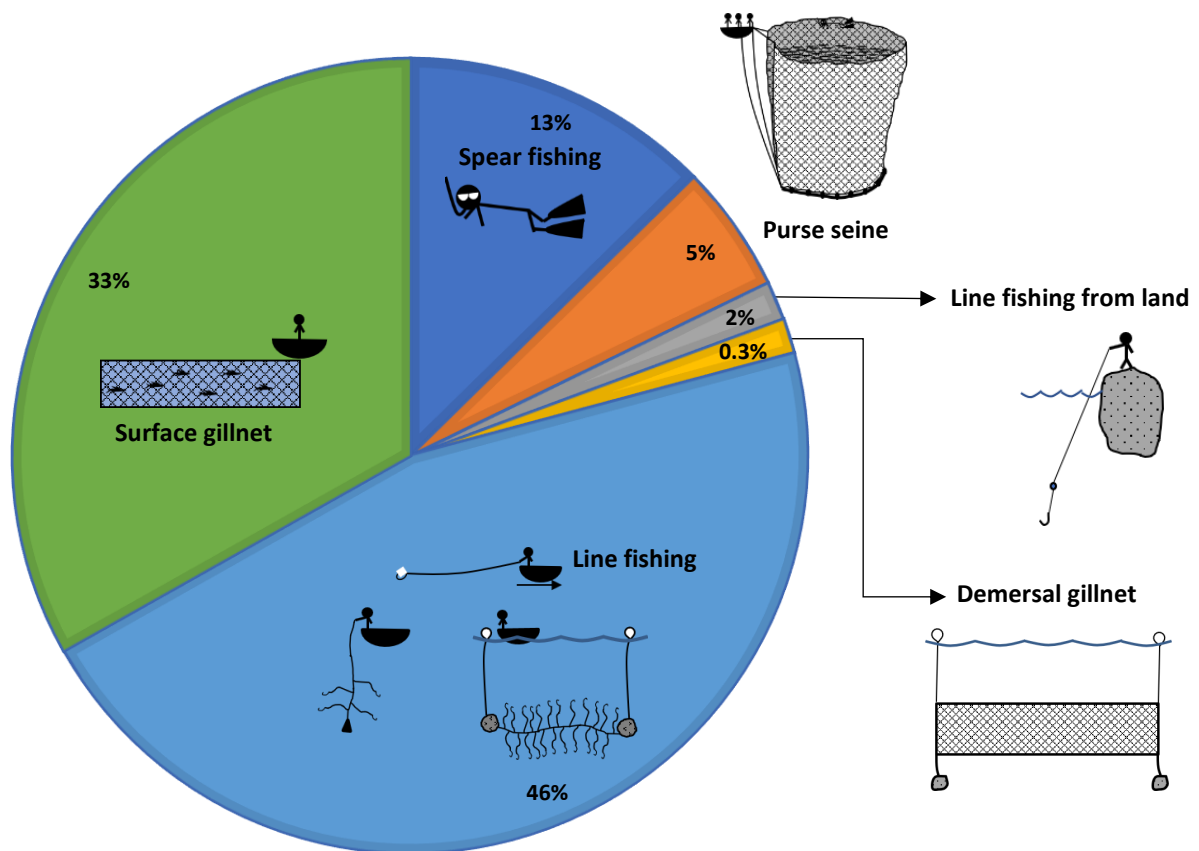


Figure 13: Percentage of trips going for each type of fishing in Príncipe.

**Landing surveys in São Tomé and Príncipe
SCIENTIFIC REPORT**

In Príncipe, 46% of the total fishing trips are vessels going for line fishing of any kind (either handline or longline, see Figure 13), and it is practised in all the communities in Príncipe. Of the 377 fishers interviewed, 292 reported doing line fishing, with a maximum of 3 line-fishing gears or techniques being used on the same trip and an average of 1.2 gears or technique per trip. The most used gear was the jigging handline with artificial bait (“*toca*”, 42% of the trips), followed by demersal troll (“*arrastão*”, 29% of the trips). Jigline fishing with baited hooks was only used in 12% of the fishing trips, mostly for targeting deep-sea fish (subcategory C, see Table 4). In total, 18% of the respondents reported using set demersal longline with baited hooks (between 150 and 800 of hooks), and 11% reported using demersal handline with baited hooks (less than 25 hooks), of which 9% reported using less than 20 baited hooks and only 2% reported using between 50 and 80 baited hooks. Only 11% of the respondents reported using different types of surface troll (corico).

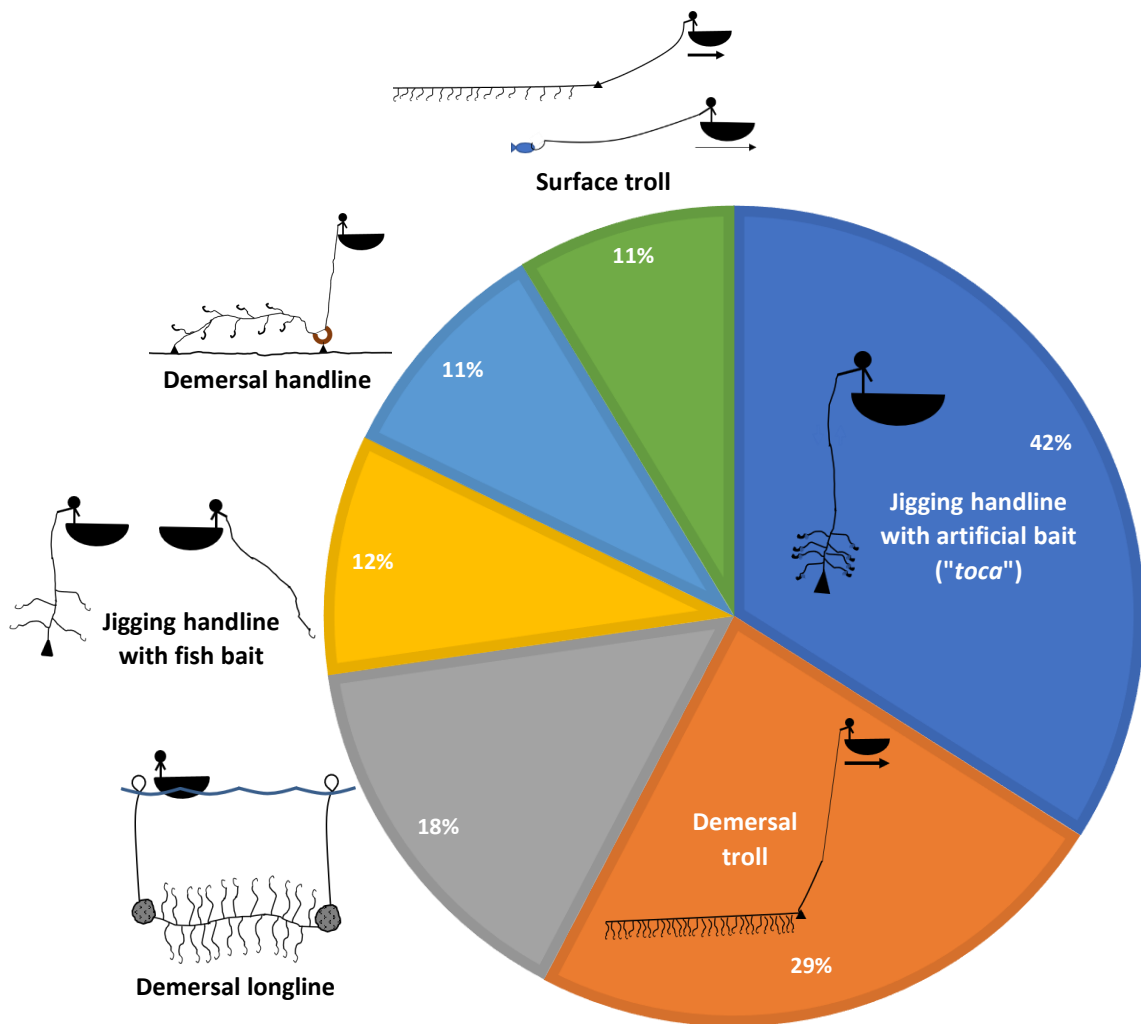


Figure 14: Types of line fishing in Príncipe island.

A third of all fishing trips in Príncipe are vessels going for surface gillnetting (“*rede voador*”, 33.2%). On average, almost 12 vessels leave daily for this type of fishing, and up to 24 vessels can depart for this type of fishing in a single day. Almost 90% of the fishing trips going for this type of fishing belong to the communities of *Água Namoro*, *Burras* and *Abade*, with the remaining 10% belonging to the communities of *Concom* and *São João*. Some communities, such as *Campanha*, *Lapa* or *Santo António* do not practise this type of fishing at all, whilst in other communities this type of fishing is even more practised than the line fishing, including the two biggest landing sites: *Burras* and *Abade*.

Landing surveys in São Tomé and Príncipe SCIENTIFIC REPORT

Spear fishing is practised in all the communities in Príncipe, except *Água Namoro* and *Santo António*. On average, 2.7 spear-fishing trips happen every day in Príncipe on the ten landing sites monitored by the project (note that spear fishers frequently use other routes or accesses, so this is probably an underestimation of the total number). The community with the highest number of spear fishing trips is *Lapa*, the most southern permanent fishing community, although most of the trips are made by fishers from the nearby community of São Miguel or even from communities in the north.

Purse seine fishing trips correspond to only 5% of the total number of fishing trips and, on average, 1.8 vessels do this type of fishing every day. This type of fishing is exclusively practised by the communities of *Abade*, *São João*, *Unitel* and *Burras*, being most frequent in *Abade* and *São João*.

Catch per unit effort, average catch per trip and per gear and gross profit have been summarised in Table 8 and Table 9. São Tomé's CPUE values for all fishing gears are significantly lower than Príncipe's CPUE values ($p < 0.01$). Further research should be done to ensure that the techniques used in both islands are comparable (for example, hook sizes are the same). The net profit per gear in Príncipe was estimated for the demersal longline (more than 100 baited hooks), purse seine, drifting surface gillnet and spear fishing. The other fishing gears are generally practised alongside other techniques and estimating the net profit requires further processing of the data.

Although the catch per trip is highest for the purse seine fishing, the net profit obtained by each fisher after subtracting the cost of fuel and renting the material is significantly lower than the other techniques (124 DOB, approx. 5€). Amongst the reasons for preferring this technique, some purse-seine fishers reported during informal interviews that the technique is faster and less tiring, with fishing trips lasting on average 7.5 hours ($n=28$) and done during the daytime. Besides the individual profit, fishers take home for consumption, on average, 3 fish per fishing trip.

The demersal longline produces an average net profit of 544 dobras per fisher (22.2€, $n=42$), with 11% of the fishing trips not catching enough fish to cover the costs. Sixty-three percent of the fishers used their own fishing materials, and 75% of all fishing trips used engine-propelled vessels. The surface gillnet produces an average net profit of 588 dobras per fisher (19.9€, $n=41$), with 14% of the fishing trips not catching enough fish to cover the costs. Sixty-six percent of the fishers rented the fishing materials and all of them used engine-propelled dugout canoes.

Spear fishing is generally practised in groups of two or three, and most of the times using a boat to commute to the fishing ground. All the trips recorded caught enough fish to cover the costs excepting two record, in which the fishing material was lost in the sea, and the average net profit was 161.38 DOB (6.59 €, $n=10$).

Catch

In total, 851.6 kg of fish are estimated to be landed in Príncipe every day, based on average number of trips per day and average catch of each type of fishing in Príncipe (see Table 10). This makes a yearly estimation of 310.8 tonnes of fish being landed in 11 permanent and temporary communities in Príncipe island (these estimations do not include the landings of *Praia Capitania* and other non-monitored landing sites, see Annex I).

**Landing surveys in São Tomé and Príncipe
SCIENTIFIC REPORT**

Table 7: Number of daily trips in Príncipe of the main categories of fishing, disaggregated by community.

SITE	Total trips (daily average)	Number of sampling days	SURFACE GILLNET (n daily trips)			PURSE SEINE (n daily trips)			DEMERSAL GILLNET (n daily trips)			SPEAR FISHERS (n daily trips)			LINE FISHING (n daily trips)		
			Mean	sd	max	Mean	sd	max	Mean	sd	max	Mean	sd	max	Mean	sd	max
Abade	7.7	17	3.4	3.2	12	0.8	0.7	2	0.0	0.0	0	0.8	1.0	4	3.2	1.7	6
Àgua Namoro	3.6	18	3.1	2.0	7	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.6	0.6	2
Burras	5.8	16	3.9	2.3	8	0.4	0.7	2	0.0	0.0	0	0.3	0.5	1	1.9	1.8	5
Campanha	1.5	17	0.1	0.2	1	0.0	0.0	0	0.0	0.0	0	0.2	0.6	2	1.3	1.2	3
Concom	2.1	18	0.6	1.0	3	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	1.5	2.0	5
Lapa	3.5	15	0.1	0.3	1	0.0	0.0	0	0.0	0.0	0	1.4	2.1	6	2.9	1.9	6
Ribeira Izé	3.0	18	0.1	0.5	2	0.0	0.0	0	0.0	0.0	0	1.6	1.8	6	1.3	1.3	4
Santo António	0.8	15	0.1	0.3	1	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.9	0.9	3
São João	2.1	11	1.0	1.5	5	0.8	0.4	1	0.2	0.4	1	0.5	0.8	2	0.9	1.0	3
Praia Seca	1.1	7	1.0	1.5	4	0.0	0.0	0	0.0	0.0	0	0.4	0.8	2	1.4	1.6	4
Unitel	3.0	15	0.1	0.3	1	0.2	0.4	1	0.0	0.0	0	0.2	0.4	1	2.9	2.1	10

**Landing surveys in São Tomé and Príncipe
SCIENTIFIC REPORT**

Table 8: Catch Per Unit Effort, weight of fish caught per gear and gross profit of the fish sales per trip for Príncipe island, disaggregated by gear. Rows coloured in grey should not be used as an indicator, due to the low sample size. Right column (Q) refers to the quality of each category as an indicator, being 0 (red) not recommended as an indicator; 1 (yellow) recommended as an indicator, although further data analysis is needed; 2 (green) recommended as an indicator.

	CPUE						WEIGHT OF FISH CAUGHT (Kg per trip)					GROSS PROFIT (DOB per trip)					Q
	Median	Mean	SD	Max	Units	N	Median	Mean	SD	Max	N	Median	Mean	SD	Max	N	
DEMERSAL GILLNET	0.00	0.11	0.16	0.38	Kg / 100m * h	5	0.0	2.5	3.6	8.0	5	0	108	158	350	5	0
DRIFT GILLNET	0.88	1.40	1.55	7.32	Kg / 100m * h	45	39.6	57.4	93.4	621.0	45	843	967	889	5040	42	2
PURSE SEINE	13.33	15.79	14.21	50.00	Kg / set	25	47.0	51.0	39.6	113.5	25	1288	1594	1359	5950	24	2
DEMERSAL TROLL (artificial bait)	2.53	3.07	2.86	16.57	Kg / 100 hooks * h	59	10.0	15.1	21.7	156.0	59	600	841	1142	7800	59	2
JIGLINE (<20 hooks with artificial bait)	2.07	2.68	3.12	22.40	Kg / line * hour	93	18.0	19.7	18.9	97.0	93	936	1077	1139	5940	87	2
JIGLINE (<20 baited hooks)	1.57	2.36	3.58	17.50	Kg / line * hour	37	6.0	9.9	10.6	50.0	39	380	563	651	3000	36	1
DEMERSAL HANDLINE (<20 fish-baited hooks)	1.43	2.35	2.05	6.79	Kg / line * hour	22	6.0	11.0	12.8	40.0	22	240	561	765	2640	21	2
DEMERSAL LONGLINE (over 100 fish-baited hooks)	1.46	1.93	1.65	7.45	Kg / 100 hooks * h	52	14.4	21.5	24.9	129.7	52	840	1263	1498	7346	44	2
SURFACE HANDLINE TROLL (<20 fish-baited hooks)	3.27	3.86	4.90	20.00	Kg / line * hour	15	6.0	11.9	14.6	55.0	15	400	758	1009	3850	15	1
SPEAR FISHING	2.50	4.34	4.56	12.33	Kg / hour	11	7.5	15.5	18.0	49.3	11	428	970	1129	2913	10	2

**Landing surveys in São Tomé and Príncipe
SCIENTIFIC REPORT**

Table 9: Catch Per Unit Effort, weight of fish caught per gear and revenue of the fish sales per trip for São Tomé island, disaggregated by gear. Rows coloured in grey should not be used as an indicator, due to the low sample size. Right column (**Q**) refers to the quality of each category as an indicator, being 0 (**red**) not recommended as an indicator; 1 (**yellow**) recommended as an indicator, although further data analysis is needed; 2 (**green**) recommended as an indicator.

Gear	CPUE						WEIGHT (Kg)					GROSS PROFIT (DOB)					Q
	Median	Mean	SD	Max	Units	N	Median	Mean	SD	Max	N	Median	Mean	SD	Max	N	
DEMERSAL GILLNET	0.42	0.42	NA	0.42	Kg / 100m * h	1	4.5	4.5	NA	4.5	1	0	0	NA	0	1	0
DRIFT GILLNET	0.21	0.21	0.30	0.43	Kg / 100m * h	2	8.0	8.0	11.3	16.0	2	291	291	411	581	2	0
PURSE SEINE	NA	NA	NA	NA	Kg / set	0	NA	NA	NA	NA	0	NA	NA	NA	NA	0	0
DEMERSAL TROLL (artificial bait)	5.37	5.37	1.71	6.58	Kg/100 hooks*h	2	7.8	7.8	3.2	10.0	2	435	435	335	672	2	0
JIGLINE (<20 hooks with artificial bait)	0.20	0.37	0.45	1.52	Kg / line * hour	15	0.8	1.5	2.4	9.1	15	0	37	92	345	15	1
JIGLINE (<20 baited hooks)	0.76	1.13	1.66	9.60	Kg / line * hour	39	2.5	3.4	3.7	18.0	41	30	99	194	1080	39	2
DEMERSAL HANDLINE (<20 fish-baited hooks)	0.00	0.00	NA	0.00	Kg / line * hour	1	0.0	0.0	NA	0.0	1	0	0	NA	0	1	0
DEMERSAL LONGLINE (over 100 fish-baited hooks)	0.27	6.04	24.89	146.76	Kg/100 hooks*h	38	2.5	39.0	144.0	753.9	38	85	216	351	1620	36	2
SURFACE HANDLINE TROLL (<20 fish-baited hooks)	0.10	1.33	2.12	7.50	Kg / line * hour	22	2.00	5.3	8.6	42.0	38	0	210	365	1500	33	2
SPEAR FISHING	1.76	7.05	18.81	87.73	Kg / hour	21	6.5	25.0	55.1	251.5	21	265	561	976	4240	18	2
JIGLINE FISHING FROM LAND	0.24	0.66	1.02	2.18	Kg / line * hour	4	0.5	1.2	1.6	4.0	5	0	0	0	0	4	0

**Landing surveys in São Tomé and Príncipe
SCIENTIFIC REPORT**

Table 10: Average catch per trip, disaggregated by fishing gears, and daily and annual estimations of fish landed in Príncipe island.

	Daily trips (see Table 7)	Sum of catch (kg)	n trips	Average catch per trip (kg)	Daily catch (kg)	Yearly catch (tonnes)
Surface gillnet	11.7	2493.7	80	31.2	364.7	133.1
Panhá	0	NA	0	NA	0.0	0.0
Purse seine	1.8	1921.8	28	68.6	123.5	45.1
Seine gillnet	0	NA	0	NA	0.0	0.0
Demersal gillnet	0.1	12.5	5	2.5	0.3	0.1
Spear fishing	4.4	170	11	15.5	68.0	24.8
Line fishing	16.2	5337.13	293	18.2	295.1	107.7

The average catch of a line fishing trip in Príncipe is 18.2 kg of fish per trip (see Table 10). This is higher than the average catch of each of the line fishing techniques (see Table 8), which is a consequence of using more than one technique per trip (on average, 1.2 techniques are used per trip). In total, 295 kg of fish are landed every day, which makes 107.7 tonnes of fish being landed every year from Príncipe's line fishery (see Table 10). Over 50% of the line fishery landings in Príncipe are carangids, of which 24% are *Caranx crysos* (blue runner), followed by *Selar crumenoptalmus* (11%, big-eyed scad), *Caranx latus* (5.3%, horse-eye jack) and *Seriola rivoliana* (3.9%, longfin yellowtail). The demersal species *Pagrus caerolusticus* (blue-spotted seabream) comprises 10.5% of the line fishing catches and another 9.9% is comprised of lutjanid snappers, of which almost a third belong to the small-sized species *Lutjanus fulgens* (golden African snapper). *Dactylopterus volitans* (flying gurnard), a bottom-dwelling species mostly found on sandy flats, comprises 7.3% of the catch. The two species of *fulu fulu* (*Euthynnus alletteratus* and *Auxis thazard*, two small tuna species frequently used as bait), comprise 3% of the catch.

The average catch of a surface drifting gillnet fishing trip in Príncipe is 31.2 kg, which makes a daily average of 364.7 kg of fish being landed every day and 133.1 tonnes of fish being landed yearly from the surface gillnet fishery. The main component of the catch is flying fish (Exocoetidae, 78.3% of the catch), followed by *Ablennes hians* (flat needlefish, 20.7% of the catch). Medium-sized (4-50 cm, pers. observation) individuals of the needlefish *Tylosurus* sp., are also often caught in the nets (0.8% of the catch).

The average catch of a purse seine fishing trip in Príncipe is 68.6 kg, which makes a daily average of 123.5 kg of fish being landed every day and 45.1 tonnes of fish being landed yearly. This technique targets schooling species, being Balao halfbeak the main component of the catch (*Hemiramphus balao*, 42% of the catch), followed by *fulu fulu* (*Euthynnus alletteratus* and *Auxis thazard*, 7.2%), mackerel scad (*Decapterus macarellus*, 5.6%), blue runner (*Caranx crysos*, 4.7%). Goatfishes of the family Mullidae are also caught with this technique (3.6 %) and small schooling barracudas of the species *Sphyraena sphyraena* (2.4%).

The average catch of a spear fishing trip in Príncipe is 15kg, which makes an average of 68 kg being caught per day with this technique in Príncipe island and 24.8 tonnes of fish being landed in Príncipe per year. Octopus, Lutjanid snappers and barracudas (*Sphyraena barracuda*) comprise up to 45% of the catch of the spear divers; and another 33% of the catch is comprised by big-sized carangids of the species *Caranx latus*, *Caranx hippos* and *Carangoides bartholomaei*. Parrotfishes (4.4%), groupers (Epiniphelinae, 2.5%) and rays (2.4%) are also caught by spear fishers.

RECOMMENDATIONS AND CONCLUSIONS

RECOMMENDATIONS FOR RECRUITING EXTENSION WORKERS AT THE COMMUNITIES:

- Recruitment process in São Tomé seems to have favoured men over women. Letting the focal points of the community to decide their representatives for collecting data might have excluded women from the selection process due to gender biases.
- Publicly calling for applications at the communities seems to achieve better outcomes in terms of promoting equal access and representation. Likewise, results from Príncipe indicate that testing the ability of the applicants to read, write and use a smartphone during the selection process is necessary for achieving better outcomes.

RECOMMENDATIONS FOR TRAINING AND QUESTIONNAIRE DESIGN:

- In order to minimise the disturbance to the fishers during the training, training should be start by representing landing scenarios, in which the trainers pretend to be fishers. Fishers should only be interviewed once the trainees are familiar with the app and the questionnaires.
- Training should not be delivered in groups of more than 3 or 4 people, to ensure that trainees with more difficulties get the support they need.
- Compulsory questions minimise the risk of skipping them being during the interview.
- Since interviewers sometimes select the wrong fishing gear, all the questions regarding fishing effort and gear (step 16, Figure 4) for each gear type should be always the same, even if for some gears some parameters might not be relevant for that specific fishing gear. For example: “*fio jogado*” is a jigging handline comprised of one big-sized, fish-baited hook. However, some extension workers have been observed to systematically select this gear instead of “*costumado*” (a jigging handline with several smaller baited hooks). Therefore, even if the question “how many hooks did you use on *fio jogado* fishing?” is not relevant (as it always uses one hook), it should be included, to account for the times when this gear is selected instead of “*costumado*”.

RECOMMENDATIONS FOR DATA MANAGEMENT AND ASSESSMENT OF DATA QUALITY:

- Sending the data to the cloud: Data from the smartphones should be sent to the cloud every two months, to minimise data loss if the device is damaged or lost.
- Assessment of data quality should be done immediately after the data has been sent to the cloud, and a subset of at least 10 data trips per month per community should be cleaned and assessed using the criteria described in Annex V. Most common mistakes should be summarised into a document to be returned to the extension workers for feedback.
- Supporting the extension workers: Extension workers should be visited periodically by the team leaders, in order to support their work, collect their feedback and raise awareness in the community about the importance of this activity. Frequency of visits should be weekly or bi-weekly in the first 6 months and at least once per month afterwards.
- Cleaning and managing the databases: Processing the data should be done following the instructions described in Annex VIII.

**Landing surveys in São Tomé and Príncipe
SCIENTIFIC REPORT**

RECOMMENDATIONS FOR USING CPUE AS A FISHERIES INDICATOR

- All CPUE values in São Tomé are significantly lower than in Príncipe. Further research should be done when a bigger database is available to ensure that the fishing techniques used in both islands are comparable. This might be related to the impacts of fishing on fish populations, which could be confirmed by analysing the average length of indicator species.
- Given the diversity of gears, CPUE should be disaggregated by gears to make it comparable. The table below includes a list of all gears and the suitability of each gear's CPUE as an indicator.

Table 11: Robustness of each gear's CPUE as a fisheries indicator.

CPUE as a fisheries indicator	
Demersal gillnet <u>Effort units:</u> kg per 100m per hour	Technique and gear rarely recorded in the landing surveys. Not recommended as an indicator.
Drifting gillnet <u>Effort units:</u> kg per 100m per hour	Technique and gear with few and small variations, mostly related to the length of the net. Recommended as indicator.
Purse seine <u>Effort units:</u> kg per set	Technique and gear with few and small variations, mostly related to the length of the net. Recommended as indicator.
Surface seine <u>Effort units:</u> kg per set	There are no records of this technique within the August-November Blue Action landings dataset.
Jigging handline with squid-shaped fishing lures <u>Effort units:</u> Kg per h per line	When a larger database is available, it should be assessed whether this technique should be disaggregated in subcategories. <u>Príncipe:</u> Technique and gear with small variations related to the number and size of the hooks. Recommended as an indicator. <u>São Tomé:</u> Small sample size (n=15), with 40% of the sample using a specialised gear for catching small bait fish. Not recommended as an indicator at this stage.
Jigging handline with fish-baited hooks <u>Effort units:</u> kg per line per hour	<u>Príncipe:</u> Major differences can be found in the number and size of the hooks, as well as the bait and the habitats targeted; which increases the variability of the data. Although it can be divided into subcategories, distinctions between them are not often clear. Can be used as an indicator but it should probably be disaggregated by categories when a larger database is available. <u>São Tomé:</u> All records of this technique in São Tomé fall within the subcategory <i>a</i> , as described in the Table 4, and show little variations in the techniques. Recommended as an indicator.
Demersal handline with baited hooks <u>Effort units:</u> kg per line per hour	Technique and gear with few and small variations, mostly related to the number and size of the hooks. Recommended as an indicator.
Demersal longline <u>Effort units:</u> kg per hour per 100 hooks	Technique and gear with small variations, mostly related to the number and size of the hooks. Recommended as an indicator.
Demersal troll <u>Effort units:</u> kg per hour per 100 hooks	Technique and gear with small variations, mostly related to the number and size of the hooks. Recommended as an indicator.
Surface handline troll <u>Effort units:</u> kg per hour per line	Gears and techniques falling within this category can be highly variable, and sample size is low. Not recommended its use as an indicator at this stage.
Spear fishing <u>Effort units:</u> kg per hour per line	Technique with small variations, mostly related to the length of the fishing trip. Recommended its use as an indicator

**Landing surveys in São Tomé and Príncipe
SCIENTIFIC REPORT**

OTHER RECOMMENDED INDICATORS

- The average length of indicator species should be also used as an indicator of the status of the different fisheries, disaggregated by deep demersal (i.e. *Dentex macrophthalmus*, *Pontinus kuhlii*), demersal (i.e. *Lutjanus fulgens*, *Pagrus caerulostictus*) and pelagic (i.e. *Coryphaena hippurus*).

REFERENCES

- Barange, M. *et al.* (2014) 'Impacts of climate change on marine ecosystem production in societies dependent on fisheries', *Nature Climate Change*, 4(March), pp. 211–216. doi: 10.1038/NCLIMATE2119.
- Belhabib, D., Greer, K. and Pauly, D. (2018) 'Trends in Industrial and Artisanal Catch Per Effort in West African Fisheries', *Conservation letters*, 11(February), pp. 1–10. doi: 10.1111/conl.12360.
- Cashion, T. *et al.* (2018) 'Reconstructing global marine fishing gear use: Catches and landed values by gear type and sector', *Fisheries Research*. Elsevier, 206(April), pp. 57–64. doi: 10.1016/j.fishres.2018.04.010.
- FAO (2004) *Handbook of fisheries statistics | Coordinating Working Party on Fisheries Statistics*.
- FAO (2015) *Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries*.
- Graaf, G. J. De *et al.* (2011) 'The status of routine fishery data collection in Southeast Asia, central America, the South Pacific, and West Africa, with special reference to small-scale fisheries', *ICES Journal of Marine Science*, 68, pp. 1743–1750.
- Jacquet, J. and Pauly, D. (2008) 'Funding Priorities: Big Barriers to Small-Scale Fisheries', *Conservation and policy*, 22(4), pp. 832–835. doi: 10.1111/j.1523-1739.2008.00978.x.
- Matos, L. and Da Graça, M. (2019) 'Caraterização das comunidades piscatórias da Ilha do Príncipe | Characterisation of the fishing communities of Príncipe Island', *Internal report for the Blue Action Project - São Tomé and Príncipe*.
- Mills, D. J. *et al.* (2011) 'Under-reported and Undervalued: Small-scale Fisheries in the Developing World', in *Small-scale fisheries management: frameworks and approaches for the developing world*. doi: 10.1079/9781845936075.0001.
- Nuno, A. *et al.* (2019) *Omali Vida Nón - Summary of project activities and preliminary results*. Available at: https://omaliprincipeen.weebly.com/uploads/2/5/6/2/25623460/summary_finalen-compressed.pdf.
- Open Data Kit (2019) *Open Data Kit Documentation*. Available at: <https://docs.opendatakit.org/>.
- Santos, A., Conceição, I. and Bolingo (2017) 'Caracterização das pescarias ativas em São Tomé | Characterisation of the active fisheries in São Tomé', *Report for the project Kike da Mungú*.
- Tous, P. (2015) 'Consulta para a avaliação dos recursos de peixes demersais', *Report to the Fisheries Department, Ministry of Economy and International Co-operation, São Tomé and Príncipe*.
- United Nations Development Programme (2013) 'São Tomé and Príncipe', *UNDP country profiles*.



ANNEXES

Annex I: fishing communities in Príncipe island

The following list contains the landing sites and fishing communities of Príncipe island. Communities or landing sites marked with an asterisk (*) have not been included in the landing surveys.

List of communities and landing sites of the autonomous regions of Príncipe	
Abade	Permanent community and landing site. Fishing community divided in “ <i>Abade Roça</i> ” (the former farm) and “ <i>Abade Praia</i> ”. It is also the landing site of fishers from <i>Nova Estrela</i> and <i>Santo Cristo</i> .
*Praia Abelha (or Praia Bumbú)	Landing site. Fishers from Terreiro Velho have been observed to land here, but no vessels are kept in this beach (personal observation).
*Praia Ponta Mina (landing site of <i>Hospital Velho</i>)	Permanent landing site. Not included in the landing surveys. Only one fisher is known to land here.
São João (neighbourhood of <i>Hospital Velho</i>)	Permanent community. Its landing site is <i>São João</i> beach, which is shared with Unitel.
Unitel (neighbourhood of <i>Hospital Velho</i>)	Permanent community. Its population was relocated from the former community of <i>Praia Sundy</i> (Sundy beach) when a resort was built. Its landing site is <i>São João</i> beach, and the fishers keep on using their former fishing grounds, which are closer to Sundy beach.
Concom (neighbourhood of <i>Hospital Velho</i>)	Permanent community and landing site.
Água Namoro (neighbourhood of <i>Hospital Velho</i>)	Permanent community and landing site.
*Praia Capitania (landing site of <i>Santo António</i>)	Permanent landing site. Not included in the surveys. Beach located below the Captaincy, that hosts 15 to 20 vessels from Bairro Chimalô and other neighbourhoods around the city.
*Bairro Chimalô (neighbourhood of <i>Santo António</i>)	Permanent community. Not included in the surveys. Its main landing site is Capitania.
Santo António (neighbourhood of <i>Santo António</i>)	Permanent community. Fishers from this community use two nearby landing sites: hestaleiro (only one fisher) and the beach of Santo António. Both sites are covered by Santo António’s extension worker.
Burras	Permanent community and landing site.
Campanha	Permanent community and landing site.
Ribeira Izé	Permanent landing site. Hosts the vessels of fishers from Sundy Roça, who will soon be relocated to the newly constructed community of “ <i>Terra prometida</i> ”. This might affect the continuity of the site (José Gomes, personal communication).
*Praia Caixão	Permanent landing site. Not included in the landing surveys. Landing site of fishers of the inland community of São Joaquim.
Praia Lapa	Permanent community. It is also the landing site of fishers from the inland community of São Joaquim.
Praia Novo	Temporary community. Temporary community of the fishers of Ribeira Izé, who migrate from November to March approximately to be closer to the southern fishing grounds.
Praia Seca	Temporary community. Príncipe’s biggest temporary settlement. It hosts fishers from all the neighbourhoods of <i>Hospital Velho</i> , as well as the inland communities of <i>Nova Estrela</i> and <i>Santo Cristo</i> .
*Praia Cabinda	Temporary community. Disappeared in a landslide. Former temporary settlement used by the fishers of Abade.

Landing surveys in São Tomé and Príncipe
ANNEXES

Annex II: fishing communities in São Tomé

From Santos *et al.* (2017)

Name	Number of fishers
NORTH	
Praias Cruz, Gamboa, Loxinga	635
Morro Peixe	176
Micoló	150
Pantufo	130
Ponte Bistp	100
Messias Alves	66
Cova Água	57
Ribeira Afonso	47
Plano Água Izé	41
SOUTH	
Porto Alegre	114
Angolares	106
Malanza	55
Praia Pesqueira	28
Ribeira Peixe	23
Angra Toldo	22
Monte Mário	17
Iô Grande	15
Ilhéu Das Rolas	

Landing surveys in São Tomé and Príncipe
ANNEXES

Annex III: Species' list

Species marked with an asterisk (*) are indicator species

Species name	English name	Code (Príncipe)	Code (São Tomé)
Acanthuridae (Surgeonfishes, tangs, unicornfishes)			
* <i>Acanthurus monroviae</i>	Monrovia doctorfish	ASNO-LACETA	ASNO-LAMINA
<i>Prionurus biafraensis</i>	Biafra doctorfish	ASNO-COTA	ASNO-COTA
Albulidae (bonefishes)			
<i>Albula vulpes</i>	Bonefish	COLUMPIAM-BALABO	COLUMPIAM-BALABO
Anguiliformes, Muraenidae (moray eels)			
<i>Channomuraena vittata</i>	Broadbanded moray	MOREIA-TROPA	MOREIA-TROPA
<i>Enchelycore nigricans</i>	Viper moray	MOREIA-CAO	MOREIA-CAO
<i>Gymnothorax vicinus</i>	Purplemouth moray	MOREIA-FULA	MOREIA-DE-TERRA
<i>Muraena melanotis</i>	Honeicomb moray	MOREIA-PINTADA	MOREIA-MAPINTA
<i>Muraena robusta</i>	Stout moray	MOREIA-RONCA	MOREIA-CARRONCA
Anguiliformes, Ophichthidae (Snake eels)			
<i>Myrichthys pardalis</i>	Leopard eel	COBRA-MARINHA	COBRA-MARINHA
<i>Ophichthus rufus</i>	Rufus snake-eel	MOREIA-FUNDO	MOREIA-CONCOM
Beloniformes, Belonidae (needlefishes)			
<i>Ablennes hians</i>	Flat needlefish	AGULHA-ESPADA	AGULHA-ESPADA
<i>Tylosurus</i> sp.	Hound needlefish	AGULHA-QUIO	AGULHA-QUIO
Beloniformes, Hemiramphidae (Halfbeaks)			
<i>Hemiramphus balao</i>	Balao halfbeak	MAXIPOMBO	MAXIPOMBO
Berycidae (Alfonsinos)			
* <i>Beryx decadactylus</i>	Alfonsino	OLHO-BRILHANTE	UE-NGUENE-NGUENE
Bythitidae (Viviparous brotulas)			
* <i>Grammonus longhursti</i>		BLONZE	BLONZE
Carangidae (jacks and pompanos)			
<i>Alectis alexandrina</i>	Alexandria pompano	PEIXE-PRATA	PAMPULE
<i>Carangoides bartholomaei</i>	Yellow jack	CHEREU	SELE
<i>Caranx crysos</i>	Blue runner	BONITO	BONITO
* <i>Caranx hippos</i>	Crevalle jack	COCOVARADO	COCOVARADO
* <i>Caranx latus</i>	Horse-eyed jack	OLHO-GROSSO	OLHO-GROSSO
<i>Caranx lugubris</i>	Black jack	OSSO-MOLE-FUNDO	COCOVARADO-DE-FUNDO
<i>Decapterus</i> sp	Mackerel scad	CAVALA	CAVALA
* <i>Elagatis bipinnulata</i>	Rainbow runner	ALADA	ALADA
<i>Selar crumenophthalmus</i>	Big-eyed scad	CARAPAU	CARAPAU
* <i>Seriola rivoliana</i>	Longfin yellowtail or Almaco jack	PEIXE-AZEITE	PEIXE-AZEITE
* <i>Trachinotus goreensis</i>	Longfin pompano	PATA-PATA2	PATA-PATA2
* <i>Trachinotus ovatus</i>	Pompano	PATA-PATA	PATA-PATA
* <i>Uraspis secunda</i>	Cottonmouth jack	OSSO-MOLE	OSSO-MOLE

Landing surveys in São Tomé and Príncipe
ANNEXES

Cirrhitidae (Hawkfishes)			
<i>Cirrhitus atlanticus</i>	West African hawkfish	CAPATAZ	CAZE-BUDU
Clupeidae (Herrings, shads, sardines, menhadens)			
* <i>Sardinella</i> sp.	Sardinella	SARDINHA	SARDINHA
Coryphaenidae (Dolphinfishes)			
* <i>Coryphaena equiselis</i>	Pompano dolphinfish	COLOMBETA-CAVEDE	COLOMBETA-CAVEDE
* <i>Coryphaena hippurus</i>	Common dolphinfish, mahi-mahi	COLOMBETA	COLOMBETA
Drepaneidae (Sicklefishes)			
<i>Drepane africana</i>	African sicklefish	COZINHEIRO	COZINHEIRO
Ephippidae (Spadefishes, batfishes and scats)			
<i>Ephippus gorensis</i>	East Atilantic African spadefish	COZINHEIRO-DE-RIO	COZINHEIRO-DE-RIO
Flying fish			
Exocetidae		PEIXE-VOADOR	VOADOR-PANHA
Haemulidae (Grunts)			
* <i>Plectorhinchus macrolepis</i>	Biglip grunt	PEIXE-PORCO	PEIXE-PORCO
* <i>Pomadasys rogeri</i>	Pignout grunt	RONCADOR	RONCADOR
Holocentridae (Squirrelfishes, soldierfishes)			
<i>Holocentrus adscensionis</i>	Squirrelfish	CAQUI	CAQUI
<i>Myripristis jacobus</i>	Blackbar soldierfish	MAE-DE-CAQUI	MAE-CAQUI
<i>Sargocentron hastatus</i>	Red squirrelfish	CAQUI-DE-FUNDO	CAQUI-DE-PEDRA
Istiophoridae (Billfishes)			
* <i>Istiophorus albicans</i>	Atlantic sailfish	PEIXE-ANDALA	PEIXE-ANDALA
* <i>Makaira nigricans</i>	Blue marlin	ESTROMBA	ESTROMBA
Kyphosidae (Sea chubs)			
* <i>Kiphusus</i> sp	Seachub	SOPA	SOPA
Labridae (Wrasses)			
<i>Bodianus speciosus</i>	Blackbar hogfish	BULHAO	BULHAO-BICA
<i>Coris atlantica</i>		RAINHA1	RAINHA1
<i>Thalassoma newtoni</i>		RAINHA2	RAINHA2
<i>Xyrichthys novacula</i>	Pearly razorfish	LAINHA	LAINHA
Lethrinidae (Emperors or scavengers)			
* <i>Lethrinus atlanticus</i>	Atlantic emperor	BICA	BICA
Lobsters			
	Lobster	LAGOSTA	LAGOSTA
	Slipper lobster	CAVACO	CAVACO
Lutjanidae (snappers)			
* <i>Apsilus fuscus</i>	African forktail snapper	PEIXE-NOVO	PEIXE-NOVO
* <i>Lutjanus agennes</i>	Red african snapper	CORVINA-PRETA	CORVINA-PRETA
* <i>Lutjanus dentatus</i>	African brown snapper	CORVINA-DE-RIO	CORVINA-DE-RIO
* <i>Lutjanus fulgens</i>	Golden African snapper	VERMELHO-TERRA	VERMELHO-TERRA

Landing surveys in São Tomé and Príncipe
ANNEXES

<i>*Lutjanus goreensis</i>	Gorean snapper	CORVINA-VERMELHA	CORVINA-VERMELHA
Malacanthidae (Tilefishes)			
<i>Branchiostegus semifasciatus</i>	Zebra tilefish	PEIXE-CABRA	PEIXE-CABRA
Mobulidae			
<i>*Mobula sp</i>	Devil ray	MARFIM	UZUA-MANTA
Molluscs			
	Octopus	POLVO	POLVO
	Sea snail	BUZIO-DO-MAR	BUZIO-DO-MAR
	Cuttlefish	CHOCO	CHOCO
Mullidae (goatfishes)			
<i>Mulloidichthys martinicus</i>	Yellow goatfish	SABONETE	SABONETE
<i>Mullus surmuletus</i>	Surmullet	SABONETE-VERMELHO2	SABONETE-VERMELHO2
<i>Pseudupeneus prayensis</i>	West African goatfish	SABONETE-VERMELHO	SABONETE-VERMELHO
Myliobatiformes (stingrays)			
<i>*Dasyatis pastinaca</i>	Common stingray	RAIA2	RAIA2
<i>*Taenuria grabata</i>	Round stingray	RAIA	RAIA
Pleuronectiformes (flatfishes)			
Pleuronectiformes	Flatfish	LINGUALE	LINGUADO
Polynemidae (Threadfins)			
<i>*Galeoides decadactylus</i>	Lesser African threadfin	BARBUDO	BARBUDO
Polyprionidae (Wreckfishes)			
<i>*Polyprion americanus</i>	Wreckfish	CHERNE	CHERNE
Priacanthidae (Bigeyes or catalufas)			
<i>*Heteropriacanthus cruentatus</i>	Glasseye	VERMELHO-SOL	VERMELHO-SOL
<i>*Priacanthus arenatus</i>	Atlantic bigeye	VERMELHO-SOL-DE-FUNDO	VERMELHO-SOL-DE-FUNDO
Scaridae (Parrotfishes)			
<i>*Scarus hoefleri</i>	Guinean parrotfish	BULHAO-PAPAGAIO	BULHAO-PAPAGAIO
<i>*Sparisoma sp</i>	Parrotfishes	BULHAO-PAPAGAIO2	BULHAO-PAPAGAIO2
Sciaenidae (Drums or croakers)			
<i>*Pseudotolithus brachygnathus</i>	Croaker	RONCADOR-DE-FUNDO	RONCADOR-DE-FUNDO
<i>*Pseudotolithus senegalensis</i>	Croaker	RONCADOR-DE-FUNDO	RONCADOR-DE-FUNDO
<i>*Umbrina cirrosa</i>	Shi drum	BARBUDO-FUNDO	BARBUDO-FUNDO
Scombridae (mackerels, tunas, bonitos)			
<i>*Acanthocybium solandri</i>	Wahoo	PEIXE-FUMO	PEIXE-FUMO
<i>*Auxis thazard</i>	Frigate tuna	FULU-FULU-REBOLA	FULU-FULU-REBOLA
<i>*Auxis thazard + Euthynnus alletteratus</i>	Little tunny and frigate tuna	FULU-FULU	FULU-FULU

Landing surveys in São Tomé and Príncipe
ANNEXES

<i>*Euthynnus alletteratus</i>	Little tunny	FULU-FULU-BATIDO	FULU-FULU-BATIDO
<i>*Katsuwonus pelamis</i>	Skipjack tuna	SINTRA	SINTRA
<i>*Scomberomorus tritor</i>	West African Spanish mackerel	PEIXE-SERRA	PEIXE-SERRA
<i>*Thunnus albacares</i>	Yellowfin tuna	ATUM-OLEDE	ATUM-OLEDE
<i>*Thunnus obesus</i>	Bigeye tuna	ATUM-FOGO	ATUM
Scorpaeniformes, Dactylopteridae (Flying gurnards)			
<i>*Dactylopterus volitans</i>	Flying gurnard	CONCOM	CONCOM
Scorpaeniformes, Scorpaenidae (Scorpionfishes or rockfishes)			
<i>*Pontinus kuhlii</i>	Offshore rockfish	CANGA	CANGA
<i>Scorpaenodes africanus</i>		COME-MOLE	COME-MOLE
Serranidae (sea basses: groupers and fairy basslets)			
<i>Anthias anthias</i>	Swallowtail seaperch	CAPITAO	CAPITAO
<i>Paranthias furcifer</i>	Creole fish	MULATO	MULATO
<i>Rypticus saponaceus</i>	Greater soapfish	FUNHE	FUNHE
Serranidae, Epiniphelinae (groupers)			
<i>*Cephalopholis nigri</i>	Niger hind	GAROPA-PRETA	COLOBO
<i>*Cephalopholis taeniops</i>	Bluespotted seabass	BOBO-QUEMA	BOBO-QUEMA
<i>*Epinephelus adscensionis</i>	Rock hind	GLOPIM	GLOPIM
<i>*Epinephelus aeneus</i>	White grouper	BACALHAU	BACALHAU
<i>*Epinephelus goreensis</i>	Dungat grouper	BADEJO	BADEJO
<i>*Epinephelus marginatus</i>	Dusky grouper	MERO1	MERO
<i>*Epinephelus morio</i>	Red grouper	MERO3	MERO3
<i>*Erythrocles monodi</i>	eryt	VERMELHO-SANGUE	VERMELHO-SANGUE
<i>*Mycteroperca rubra</i>	Mottled grouper	MERO2	MERO2
Sharks			
<i>*Carcharias or carcharinus</i>		TUBARAO-BRANCO	TUBARAO-BRANCO
<i>*Ginglymostoma cirratum</i>	Nurse shark	TUBARAO-AREIA	TUBARAO-AREIA
<i>*Prionace sp.</i>	Blue shark	TUBARAO-LAGAIA	TUBARAO-LAGAIA
<i>*Rhizoprionodon</i>	Requiem shark	TUBARAO-PEIXE	TUBARAO-PEIXE
<i>*Sphyrna sp.</i>	Hammerhead	TUBARAO-MARTELO	TUBARAO-MARTELO
Sparidae (porgies)			
<i>Boops boops</i>	Bogue	BONGA	BONGA
<i>*Dentex congoensis</i>	Congo dentex	BESUGO	VERMELHO-DENTE
<i>*Dentex macrophtalmus</i>	Large-eyed dentex	VERMELHO-FUNDO	VERMELHO-FUNDO
<i>*Pagellus bellottii</i>	Red pandory	MALAGUETA	MALAGUETA
<i>*Pagrus caerulostictus</i>	Bluespotted seabream	PARGO	PARGO
<i>*Pagrus pagrus</i>	Red porgy	PARGO	PARGO
Sphyraenidae (Barracudas)			
<i>*Sphyraena barracuda</i>	Great barracuda	BARRACUDA	BARRACUDA
<i>Sphyraena sphyraena</i>	European barracuda	PESCADA	ALICHOTE
Syngnathiformes, Fistulariidae (Cornetfishes)			

Landing surveys in São Tomé and Príncipe
ANNEXES

<i>Fistularia tabacaria</i>	Cornetfish	AGULHA-BUZINA	AGULHA-BUZINA
Tetraodontiformes, Balistidae (triggerfishes)			
* <i>Balistes capriscus</i> (= <i>Balistes carolinensis</i>)	Grey triggerfish	ASNO-FUNDO	ASNO-FUNDO
* <i>Balistes punctatus</i>	Blue-spotted triggerfish	ASNO-GALINHA	ASNO-TERRA
* <i>Canthidermis sufflamen</i>	Ocean triggerfish	ASNO-OCEANICO	ASNO-MAMBO
* <i>Melichthys niger</i>	Black triggerfish	ASNO-PRETO	ASNO-PRETO
Tetraodontiformes, Monacanthidae (filefishes)			
<i>Aluterus scriptus</i>	Scribbled leatherjacket filefish	ASNO-PERGUICOSA	ASNO-LEMBE-LEMBE
Tetraodontiformes, Tetraodontidae (puffers)			
<i>Lagocephalus laevigatus</i>	Smooth puffer	COELHO	COELHO
Others			
NA	NA	DOBRADA	MAZEBE
Species not included in the list	NA	OUTRO-PEIXE	OUTRO-PEIXE

Landing surveys in São Tomé and Príncipe
ANNEXES

Annex IV: Assessment of the work of extension workers – training phase

The following tables describe the criteria used to assess the work of the extension workers during the training phase in São Tomé. Scores on each parameter were assigned based on the subjective criteria of the trainer, Guillermo Porriños.

	Nº training sessions	Using ODK and the smartphone		Understanding the questionnaire		Interview		Total		Final assessment	Engaging the fishers
		Beg.	End	Beg.	End	Beg.	End	Beg.	End		
Community 1	5/5	0	1.5	1	2	1	2	0.7	1.8	Not able to conduct the work	2
Community 2	5/5	1	2	1	2	1	2	1.0	2.0	Able to conduct the work, but needs support	3
Community 3	6/6	3	3	3	3	3	3	3.0	3.0	Able to work independently	3
Community 4	4/4	3	3	3	3	3	3	3.0	3.0	Able to work independently	2
Community 5	5/5	0	2.5	0.5	3	1	2.5	0.5	2.7	Able to work independently	1
Community 6	3/5	0	1.5	1	1.5	0	1.5	0.3	1.5	Not able to conduct the work	3
Community 7	3/4	2.5	2.5	2	3	2	3	2.2	2.8	Able to work independently	3
Community 8	6/6	1.5	2	2	2.5	2	2.5	1.8	2.3	Able to conduct the work, but needs support	3
Community 9	3/3	3	3	3	3	3	3	3.0	3.0	Able to work independently	2
Community 10	4/4	3	3	3	3	3	3	3.0	3.0	Able to work independently	3

Assessment criteria
Using ODK and the smartphone: Using a smartphone android independently, including navigating the different applications, writing using a touchscreen keyboard, etc.
Understanding the questionnaire: Understanding the questions, the type of information and its meaning.
Interview and data collection: Conduct the interview independently and develops strategies to collect the information (weighing, counting...), considering the complex dynamics of the landings.
Engaging the fishers in the activity: Explaining the fishers the activity, how and when it will happen, why it is done and its importance.

Scores
0 → Does not manage to perform the task, even when explained.
1 → Does not manage to perform the task but manages when explained.
2 → Manages to perform the task, but needs support
3 → Manages to perform the task independently.

Landing surveys in São Tomé and Príncipe
ANNEXES

Annex V: Criteria for the assessment of data quality

The following table describe the criteria used to assess the work of the extension workers during the training phase in São Tomé.

Data frame	Weight	Description
Number of interviews and daily number of boats	1	Filled the form on the number of daily trips every day.
	3	Filled all the information on the daily number of canoes.
	7	The number of interviews conducted corresponds to the expected number of canoes departing from that community (at least 6 interviews per working day for big communities).
General information of the fishing trip	1	Landing and departing times are correct.
	1	Recorded the names of all the fishers.
	1	Recorded the correct type of vessel, as well as the amount of fuel and the price, if relevant.
	1	Recorded the fishing ground.
	1	Recorded the number of fish that the fisher kept for consumption, as well as the number of fish given as a tip (São Pedro).
	1	Recorded whether the fisher had any problems while fishing.
Fishing effort	2	Recorded all the fishing gears used by the fisher.
	2	Recorded the correct fishing gears.
	5	Recorded the type of fish caught with each gear.
	2	Recorded the times when the fisher was fishing with each gear.
	1	Recorded the number of times that the fishing gear was deployed (if relevant).
	1	Recorded the size of the hook or mesh, bait type and whether night lights were used (if relevant).
	5	Recorded length and depth of the net and the number of hooks and lines.
	5	Recorded all the species caught.
Catch	1	Recorded the correct species.
	3	Counted and weighed all the fish.
	2	Recorded the use given to the fish (consumption, salted, sold...)
	2	Recorded the correct prices
	2	Recorded the units used to sell the fish (kg? n fishes?)
Indicator species	1	Took a picture of the indicator species asked by the form.
	2	Took a picture of at least 10 fish.
	2	Took the picture from above and using the reference for size.

Landing surveys in São Tomé and Príncipe
ANNEXES

Annex VI: Assessment of Príncipe's data quality

Percentage of data properly collected in Príncipe during August and September, using the criteria described in Annex V.

Criterium	Community 1		Community 2		Community 3		Community 4		Community 5	
	Aug-19	Sep-19	Aug-19	Sep-19	Aug-19	Sep-19	Aug-19	Sep-19	Aug-19	Sep-19
Recording number of daily fishing trips and canoes and number of interviews conducted	100%	100%	100%	100%	100%	100%	80%	100%	100%	100%
General information of the trip	98%	100%	96%	99%	91%	96%	95%	100%	98%	100%
Fishing effort	100%	100%	85%	99%	66%	71%	89%	76%	71%	99%
Catch	99%	73%	93%	89%	94%	100%	100%	100%	86%	100%
Picture of the indicator species	27%	36%	55%	75%	22%	100%	68%	60%	20%	100%
TOTAL	92%	86%	87%	94%	76%	88%	90%	87%	76%	100%

Criterium	Community 6		Community 7		Community 8		Community 9		Community 10	
	Aug-19	Sep-19	Aug-19	Sep-19	Aug-19	Sep-19	Aug-19	Sep-19	Aug-19	Sep-19
Recording number of daily fishing trips and canoes and number of interviews conducted	100%	100%	100%	100%	20%	50%	100%	100%	100%	100%
General information on the trip	100%	100%	100%	100%	96%	100%	99%	99%	94%	99%
Fishing effort	98%	100%	63%	77%	75%	79%	82%	87%	67%	65%
Catch	92%	100%	83%	83%	50%	50%	97%	99%	84%	92%
Picture of the indicator species	33%	84%	60%	60%	80%	80%	72%	100%	0%	60%
TOTAL	90%	98%	77%	82%	66%	71%	89%	95%	72%	80%

**Landing surveys in São Tomé and Príncipe
ANNEXES**

Annex VII: Assessment of São Tome’s data quality

Percentage of data properly collected in São Tomé in October 2019, using the criteria described in Annex V.

CRITERIUM	Com. 1	Com. 2	Com. 3	Com. 4	Com. 5	Com. 6	Com. 7	Com. 8	Com. 9	Com. 10
	Oct. 19	Oct. 19	Oct. 19	Oct. 19	Oct. 19	Oct. 19	Oct. 19	Oct. 19	Oct. 19	Oct. 19
Recording number of daily fishing trips and canoes and number of interviews conducted	8%	69%	7%	92%	76%	49%	75%	21%	1%	109%
General information of the trip	80%	97%	92%	100%	98%	95%	95%	54%	NO RECORDS	95%
Effort	87%	95%	92%	85%	97%	94%	100%	60%	NO RECORDS	100%
Catches	24%	95%	88%	99%	86%	88%	77%	0%	NO RECORDS	90%
Picture of indicator species	0%	76%	27%	80%	80%	78%	72%	0%	NO RECORDS	84%
TOTAL	52%	90%	71%	92%	89%	84%	86%	30%	1%	96%

Annex VIII: Protocol for processing the data

Data is sent every two months from the tablets to a google drive account. To access the drive, request access to any of the project managers. Data needs to be restructured before it can be analysed, which is done automatically using a spreadsheet which restructures the data into four independent databases.

PRINCIPE

- 1) Download the workbook "*principe_converter.xlsx*" from [this link](#), which automatically restructures the data and removes the variables that are not necessary.
- 2) Landing data is stored in the online spreadsheet "*dados-pesca-pc-v.Oct2019*" stored in the landing surveys' drive. Copy all the data (including the headings) and paste it in the cell C1 of the spreadsheet "raw-dp". Calculations might take a while to be completed. Up to 1500 data entries can be introduced into the spreadsheet.
- 3) Data on the daily number of canoes is stored in "*registo-trabalho-pcp*". Copy all the data and paste it in the cell B1 of "raw-n_trips". Calculations might take a while to be completed. Up to 438 entries can be introduced into the spreadsheet.
- 4) Data is automatically restructured and trimmed into the spreadsheets "N_TRIPS", "GENERAL_INFO", "CATCH" and "EFFORT". It is recommended to export them as csv files to reduce the size of the file. The csv files can be directly analysed in R or opened with any spreadsheet software, such as Libre Office or Microsoft Office.
- 5) The workbook "*principe_converter.xlsx*" containing the raw data should be saved as a copy with the data in the name of the file, in order to keep a backup of the data. Data from the online spreadsheets "*dados-pesca-pc-v.Oct2019*" and "*registo-trabalho-pcp*" must be copied into new spreadsheets in the folder "*dados*" in the landing surveys' drive and cleared from the original spreadsheet to reduce its size (the headings MUST be kept).

This process should be done every two months.

SÃO TOMÉ

Download the workbook "*sao_tome_converter.xlsx*" from [this link](#), and follow the steps previously described. Landing data is stored in the online spreadsheet "*dados-pesca-st-v.Oct2019*" and the data on the daily number of canoes is stored in the online spreadsheet "*registo-trabalho-ST-v.Oct2019*".