Reducing the extinction risk of the three Critically Endangered birds of São Tomé

Final Project Report

São Tomé Obo Natural Park

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Executive summary

The island nation of São Tomé and Príncipe (STP) is a hotspot of endemism, the archipelago has a tiny land area (1001 km^2), supporting no fewer than 28 endemic bird species (and many endemic subspecies), over 100 endemic plant species, a whole family of endemic land snails, and several endemic species of mammal, amphibian and reptile. Of the endemic birds of São Tomé (ST), 10 are listed by BirdLife International/IUCN as Globally Threatened, three of these falling into the highest category Critically Endangered (CR), including the; Dwarf Olive Ibis *Bostrychia bocagei,* São Tomé Fiscal *Lanius newtoni* and São Tomé Grosbeak *Neospiza concolor.* All are endemic to ST with restricted range and decreasing populations, threatened by forest loss from large-scale agricultural project development, disturbance, hunting and introduced non-native species. Immediate action is needed to protect, and support the recovery of these threatened species and tropical forest habitat. The purpose of the project is therefore to protect and conserve forest habitat on São Tomé to reduce the extinction risk of the 3 CR birds and benefit globally threatened endemic biodiversity, in partnership with key stakeholders.

Main objectives for this project were to: 1, identify the distribution and abundance of the three CR and to increase knowledge of the breeding ecology and habitat requirements of the Dwarf Olive Ibis; 2, update CR conservation accounts and action plans to inform conservation solutions, including in Obô Natural Park; 3, target advocacy communications and awareness raising, to secure greater commitment from key stakeholders to reduce the extinction risk of all three CR; and 4, establish annual monitoring programme to collect data on abundance and distribution of globally threatened birds and develop national capacity to sustain it.

Systematic surveys of ST's main forest block took place between 2013 and 2015. We obtained records of new areas of occurrence for the three target species. Across the whole year, the potential area of occurrence was of 127 km^2 for the Ibis, 117 km^2 for the Fiscal and 174 km^2 for the Grosbeak. The southwest central region of ST has high potential for the occurrence of the three CR birds, and was thus identified as the most important area of the island, which largely coincides with the core area for the ONP. The three species showed a preference for old-growth forest. Additionally, the Dwarf Olive Ibis selected areas with higher number of trees, while the Fiscal preferred a lower number of trees and intermediate altitudes. We also found that none of these species is restricted to lowland specialists. Despite very restricted ranges, population sizes seem to be larger than previously assumed. These results suggest that the Fiscal and Grosbeak might be better classified as 'Endangered', while the Ibis should maintain its status under different criteria, due to a very restricted range during the breeding season.

Key results and achievements include:

- New field data is available on the 3 CR birds
- New field data is available on globally threatened endemic biodiversity of the island and held in a São Tomé species database

- New information is available on the distribution, population sizes, conservation status and habitat requirements for the 3 CR species
- Increased knowledge on threats and drivers of status
- Peer-reviewed scientific paper published in Bird Conservation International
- Development of protocol to monitor forest biodiversity and threats related to human activities with transects completed twice up to date
- Workshops held with key stakeholders, including Government staff and STP NGO's, engaging them in the delivery of the Species Action Plans, and species and forest conservation
- Strong relationships built with key Government staff
- Partnership built between project team, BirdLife Africa and local based Portuguese NGO Oikos and execution of small project funded by Synchronicity Earth
- Preparation of 4/5 year project already submitted to larger funding from EU and waiting for approval
- Meetings held with key Government staff to identify key threats and challenges and raise the profile and status of species
- Advocacy work relating to land-use change and development has been effective, including our inputs on hydropower development and oil-palm, both of which have attained high profile in the Government, focussed on ensuring Environmental legislation is considered within the discussions and on developing adequate mitigation and compensation measures
- Provision of information and inputs to revise Obô Natural Park (ONP) Management Plan
- Excellent progress made by the local field staff, which now has the capacity to implement the field surveys and monitoring independently

Objective 1: The distribution and abundance of the Dwarf Olive Ibis, São Tomé Fiscal and São Tomé Grosbeak are identified and knowledge of the breeding ecology and habitat requirements of the Dwarf Olive Ibis is increased.

1.1 Survey work methods

Field staff during survey work

Systematic surveys of ST's main forest block took place between 2013 and 2015. The study area was divided into 99 square tetrads of 4 km^2 (Fig. 1). We surveyed a randomly selected quarter of each tetrad throughout the study area and more intensively in some areas, such as the southeast (de Lima et al. 2013b). In each 1 km^2 quarter we undertook five, 10 minute point counts, separated by at least 200 m. When feasible, point counts were scattered across the 1 km^2 quarter so as to represent environmental variability in proportion of its availability, namely in terms of habitat type, altitudinal gradients, and distance to rivers and roads. The number of individuals of each CR bird species detected during each point count was recorded, including whether they were within 20 m. The location and altitude of each point was registered using a GPS. Habitat at each point was assessed in terms of broad land-use type, slope, number of trees and understorey density (Table 1). To assess seasonality, sampling took place during the main dry season of 2013 and 2014, *gravana*, and during the *gravanito* of 2014 and 2015, which corresponds to a small dry season at the end of the breeding season for most bird species in São Tomé (Jones and Tye 2006).

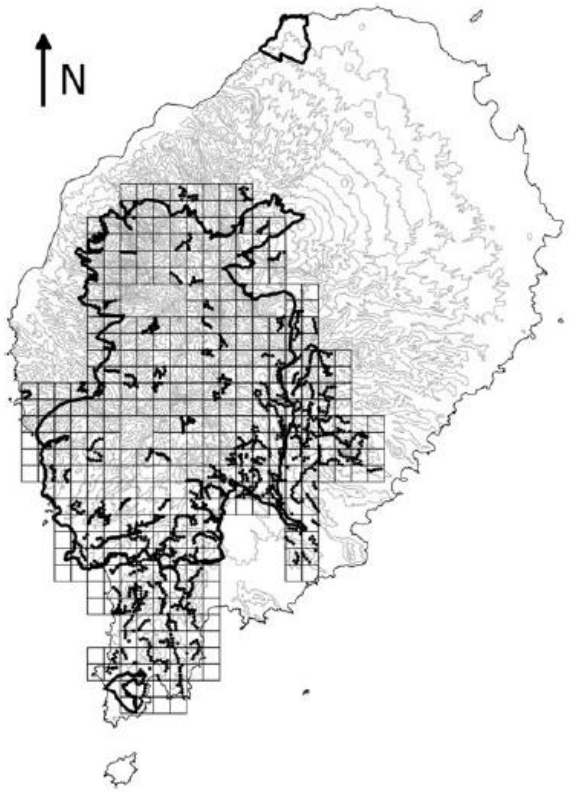


Figure 1 – Map of São Tomé Island showing study area. Squares represent 1 km^2 quadrats in the study area, with dots indicating systematic point counts. Boundaries of the São Tomé Obô Natural Park are shown by the bold black lines. The 100 m contour lines are shown in grey in the background.

Table 1 – Habitat characteristics assessed in the 20 m surrounding each point count location.

Characteristic	Description
Habitat type	Native forest, secondary forest or plantation
Slope	1 – none or very soft; 2 – soft; 3 – medium; 4 – steep; 5 – very steep
Number of trees	Count of all trees with diameter at breast height larger than 30 cm
Understorey density	1 – none or very sparse; 2 – sparse; 3 – medium; 4 – dense; 5 – very dense

1.2 Survey results

We sampled 720 point counts during the *gravanito* and 960 during the *gravana*. In total we recorded 33,137 birds, belonging to 39 species, including the 20 endemic species and all endemic subspecies, except the Harlequin Quail *Coturnix delegorguei histrionica* and the Barn Owl *Tyto alba thomensis*. We detected 38 Ibises in 21 point counts, 111 Fiscals in 86 point counts and 22 Grosbeaks in 16 point counts.

The larger sampling effort during the *gravana* was not reflected in records for the critically endangered birds, with just 18 Ibises in 8 points, 46 Fiscals in 35 points and 3 Grosbeaks in 3 points from this season. The comprehensive survey of São Tomé forests has allowed, together with information gathered from other researchers, a significant improvement on our knowledge about the distribution, ecology and conservation status of the São Tomé Dwarf Olive Ibis, Fiscal and Grosbeak.

We have greatly increased the number of confirmed locations for all of São Tomé's Critically Endangered bird species, and gained a better understanding of the distribution of their potential habitats. We found that the potential distribution of both the Ibis and the Fiscal are much more restricted than previously assumed, having changed from 213 to 127 km^2 and from 260 to 117 km^2, respectively. The Grosbeak, on the other hand, seems to be more widespread, with surveys having extended its potential range from 88 to 187 km^2. The Ibis also seems to have strong seasonal changes in distribution, being restricted to just 65 km^2 during its breeding season in the *gravanito*. All target species are strongly restricted to the south of the island, and notably to the south-west. The ONP covers most of the areas with high potential for the three species, but leaves out 38 km^2 (82.7%) of the top 25% priority areas. These include around 20 km^2 between the Iô Grande river and Maria Fernandes Peak to the east of ONP, and smaller areas next to Juliana de Sousa (west), Caué river and Monte Carmo (south border), and Calvário and Nova Ceilão. The ONP is well located for the protection of São Tomé's Critically Endangered bird species, especially considering that it aims to protect many other biodiversity components.

We confirmed that all target species are strongly linked with the occurrence of native forest, indicating that the protection of this forest is key to ensuring the long-term survival of three bird species. Habitat degradation has been listed as a key threat to their survival (Ndang'ang'a *et al.* 2014) and it seems to have a negative impact on all species: the Fiscal is restricted to native forest, while the Ibis and the Grosbeak appear to occur at lower densities in secondary forests, but only if these are mature and in the vicinity of native forest.

The Ibis's association with lowland forests in flat areas and with large trees makes it especially prone to human activities that also tend to occur in these areas, such as hunting, logging and deforestation. The apparent concentration of the Ibis around the south-west of the ONP during the breeding season is particularly concerning, since this region is being targeted for development, including a 30-km^2 oil palm monoculture and plans for a hydroelectric dam. Of São Tomé's Critically Endangered bird species, the Ibis is also the only one targeted by hunters (Carvalho *et al.* 2015) which is a key threat to its survival. The Fiscal was the only species restricted to native forest. This might suggest it is the most sensitive to habitat degradation but, on the other hand, its preference for rugged inaccessible areas makes it less vulnerable to the direct impact of human activities. Despite the many new records, the Grosbeak remains the least seen and most mysterious of São Tomé endemic bird species. The significant change in the number of records between seasons (two birds detected during the *gravana*, against 18 during the *gravanito*) suggests that the scarcity of records might be due to its shyness and not necessarily due to a very low population size. Therefore, the Grosbeak might be more widespread and numerous than previously thought.

1.2.1 Species distributions

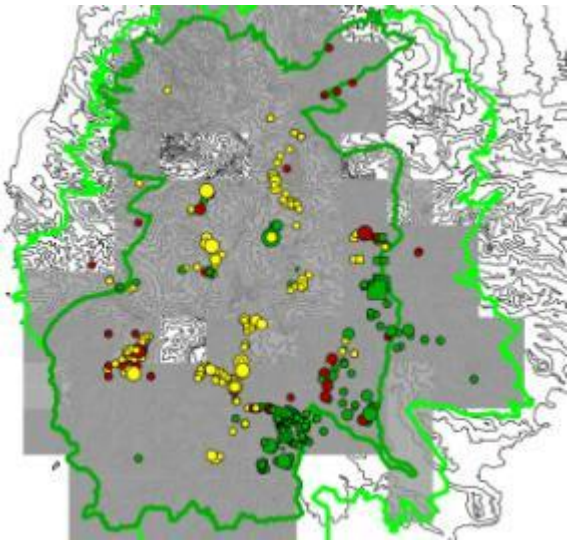


Figure 2 – Map of the records for 3 Critically Endangered birds on São Tomé island. The grey squares represent surveyed areas. The green lines indicate Obô Natural Park boundaries (darker green = core park, lighter colour = buffer zone). Green records are for the Dwarf Olive Ibis, yellow records are for the São Tomé Fiscal and red records for the São Tomé Grosbeak. Background black lines are 50m altitudinal isohyets.

We obtained records of new areas of occurrence for the three target species. The Ibis was registered along the Lembá, Ana Chaves and Yo Grande river valleys, and in the proximities of the Maria Fernandes Peak, outside the ONP. The fiscal seems to occur mostly at mid altitudes south of Pico de São Tomé and around the Cabumbé Peak. The distribution of the grosbeak was particularly expanded, with records from Morro de Dentro, Ana Chaves Peak, the Lembá river valley and the southeast slopes of Cabumbé Peak, with its presence in altitude being confirmed at several locations (Fig. 2).

The variables related to precipitation, namely during the wettest and warmest months, to NDVI, especially in June, and to elevation were the best predictors of the presence of the three target species for the annual models. The variables related to precipitation were consistently chosen as predictors for the presence of the bird species across the seasons, and notably for the Ibis.

Across the whole year, the potential area of occurrence was of 127 km^2 for the Ibis, 117 km^2 for the Fiscal and 187 km^2 for the Grosbeak (Table 2). During the main dry season these areas expand over 165 km^2 for the Ibis, 197 km^2 for the Fiscal and 190 km^2 for the Grosbeak, while in the small dry season they change to 65, 113 and 201 km^2, respectively. There is a strong spatial overlap in the seasonal distribution of each species, with the ibis exhibiting the most accentuated seasonal changes in distribution (Fig. 3).

The southwest central region of ST has high potential for the occurrence of the three CR birds, and was thus identified as the most important area of the island in the output of the zonation analysis (Fig. 3d). This key area for conservation is largely coincident with the core area for the ONP, namely for the top 10 % and 25 % thresholds.

Figure 3 – The categorical model for the annual distribution of São Tomé Dwarf Olive Ibis (a), Fiscal (b) and Grosbeak (c), as predicted by logistic MaxEnt modelling. Quadrats in red are suitable, while those in black are unsuitable. Zonation (d) is also shown, with the warmest colours indicating the most important conservation areas and the coolest colours indicate the least important conservation areas (0-19% = black, 20-49% =dark blue, 50-74% = light blue, 75-89% = yellow, 90-94% = pink, 95-97% = dark red and 98-100% = light red).

1.2.2 Species population estimates

We estimated the Ibis to occur at densities of 41.70 birds per km^2, the Fiscal at 30.17 and the Grosbeak at 12.71, based on the average population density recorded by point count, within a 20 m radius and within the potential area of occurrence of each species. Extrapolations for the potential area of occurrence indicate the existence of sufficient suitable habitat for 5296 Dwarf Olive Ibises (4619 to 5897 for a 95% confidence interval), 3530 Fiscals (3057 to 3951 for a 95% confidence interval) and 2212 Grosbeaks (1958 to 2436 for a 95% confidence interval) (Table 2). This study compliments the project undertaken by student researcher Francisco Azevedo from the University of Évora.

Table 2 - Parameters used to estimate the number of birds that could be supported on São Tomé, for each of its critically endangered bird species.

Species	**Estimated area of occurrence (EAO – km^2)**	**Number of point counts (size)**	**Average population density (birds/km^2)**	**Number of birds in the EAO (mu - 95 % confidence interval)**
Ibis	127	229	41.70	5296 (4619-5897)
Fiscal	117	211	30.17	3530 (3057-3951)
Grosbeak	174	313	12.71	2212 (1958-2436)

However, these estimates are based on data that is sensitive to errors, namely on the extent of potentially suitable habitat from models and on the density estimates. The models we used might have been miss-specified and overestimate distribution, or might not have included all factors that limit the population of these species, while the density estimates might be inaccurate, since they are based on the very few observations of the target species within a 20 m radius of the point counts.

1.2.3 Priorities for future research

Most of the areas where the native forest persists are difficult to access due to the very rugged terrain and very high annual rainfall. These natural conditions have guaranteed protection from human interference, but have also made it difficult to study their ecosystems and species. This study is part of the most intensive systematic biological survey of these remote areas, during which data on other *taxa* (e.g. terrestrial vertebrates, land snails and plants) was also collected, improving knowledge of their distribution, ecology and conservation status (e.g. de Lima *et al.* 2016). These surveys have collected extensive evidence of the importance of the native forest for maintaining many of the island's endemic species, but have also shown that each species relies on specific areas of the forest for its survival. For instance, while the Ibis is associated with high tree density in the lowlands, the Fiscal seems to prefer lower tree densities at intermediate altitudes. These specific habitat associations pose a challenge to conservation prioritisation and intervention, as they demand a differential treatment of ecosystems to ensure the persistence of multiple biodiversity components. It is therefore crucial to keep improving our understanding of the relationship between species and ecosystems.

All target species were found more often during the *gravanito*. This suggests that they become more abundant or easier to detect during this season, and further supports the hypothesis that it coincides with the breeding season for most bird species in São Tomé, as has been previously described (Jones and Tye 2006, Maia *et al.* 2014, Margarido 2015). This finding also indicates that this is most likely the best time of year to census these species. Since resources for monitoring are likely to be scarce, we would prioritise having more robust data for a single season, than dispersing resources in multiple-season assessments, thus maximising detection by surveying when the species are easier to find. Estimating and monitoring population sizes, following specific censuses for each species should be a top research priority, to ensure a better sustained revision of the conservation statuses and provide bases for evidence-based management.

A key priority for further research is to gain a better understanding of the role of potential threats, such as the collection of forest products (timber, charcoal, quarry species, palm wine, medicinal plants) and introduced animal and plant species. Tackling the hunting of the Dwarf Olive Ibis is also a top priority, as it seems to be posing an immediate threat to the survival of this species and depends on complex socio-economic drivers (Carvalho *et al.* 2015). This is essential when considering the species' restricted breeding range, alongside the fact that hunting pressure may already be limiting the population density in the areas of suitable habitat we have identified.

1.2.4 Implications for conservation

We confirmed that all of São Tomé's Critically Endangered bird species have a very limited distribution, strongly associated with the occurrence of the best preserved patches of native forest. These are mostly located in the centre and south-west of the island and within the ONP, which despite its legal recognition is weakly enforced. Increasing the effectiveness of the park is key to ensuring the long-term survival of São Tomé's most threatened avifauna and native forest ecosystems. Nevertheless, it requires significant investment, given the current staff and logistical limitations of the protected area authority. If São Tomé's tropical forest ecosystems and globally threatened biodiversity are to be protected, particular attention

needs to be focused on developing and implementing a rigorous enforcement and surveillance programme, which in turn depends on the identification and development of a sustainable financing approach.

Our work has also shown that even the most threatened species might occur outside the ONP boundaries and use secondary forests. These results are a sign of hope for the future of these species, but should be taken with caution since they represent an improvement on the knowledge about their situation rather than a change in their conservation status. It would be important to better understand the conditions in which they use these areas, to expand suitable habitat through habitat management, control of human activities and expanding the existing network of protected areas in the island. Much of these secondary habitats fall within a proposed buffer zone, which is under threat from large-scale commodity development, while awaiting legal recognition. Improving the protection of key ecosystems outside the only existing protected area and developing an effective management framework for a more sustainable use of resources in edge forest ecosystems is also critical to protect São Tomé's unique biodiversity.

1.3 Habitat associations and ecology

We recorded the Ibis in 13 point counts with complete habitat characterization, the Fiscal in 75 and the Grosbeak in 12. Comparing the habitats characteristics of these locations with that of an equal number of unoccupied locations, indicated that the three species showed a preference for old-growth forest. Additionally, the Dwarf Olive Ibis selected areas with higher number of trees and the small dry season, while the Fiscal preferred a lower number of trees and intermediate altitudes. We also found that none of these species is restricted to lowland specialists, with the Ibis being recorded up to 950 m a.s.l., the Fiscal up to 1500, and the Grosbeak up to 1400.

1.3.1. Dwarf Olive Ibis habitat selection study

Dwarf Olive Ibis

The project worked with Neide Margarido, a student researcher from the University of Évora, supporting her study on the habitat selection of the Dwarf Olive Ibis. The section below has been provided by Neide Margarido. This work focused in the forests of Monte Carmo, Ribeira Peixe (Fig. 4),

inside ONP, in the southern central region of ST Island, which corresponds to the southern limit of Dwarf Olive Ibis distribution. The study area comprises some of the island's best preserved native lowland forests intercalated with secondary forests, which hold higher proportions of exotic and fast growing species (Peet & Atkinson, 1994).

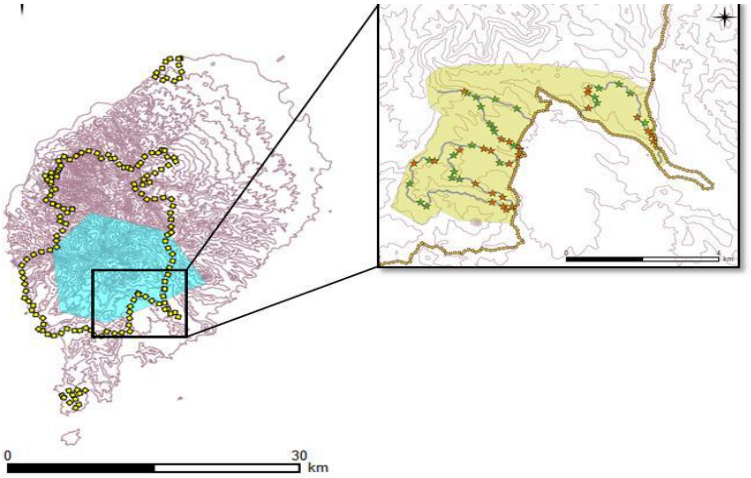


Figure 4- Location of the study area in the island of São Tomé. The distribution area of the Ibis is shown in blue, the border of the PNOST by the yellow dots and the 50 m altitude isolines in purple. The inset shows the study area in green, the transects in grey. The green starts represent the sampling points with Ibis and the red ones the random points.

Methods

The study defined 5 transects of variable length, which totalled 28 km. To detect the presence of Ibis, the transects were sampled three times, on foot and at constant pace, between September and November 2014. A list of environmental variables were assessed in each sampling point (Table 3).

Table 3- List of environmental variables assessed in the sampling points.

Variable	Description
maximum height	Height of the tallest trees in a 25 m radius.
number of large trees	Number of trees with DBH > 40 cm in a 50 m radius.
total number of trees	Number of trees with DBH > 10 cm in a 50 m radius.
density of lianas	Density of lianas in a 25 m radius on a scale of 0 to 5 (Dallimer *et al*., 2009).
density of woody debris	Density of woody debris in a 25 m radius on a scale of 0 to 5 (Dallimer *et al*., 2009).
canopy cover	Average of the measurements of percentual canopy cover taken with a convex densiometer in 4 opposite directions and 5 m away from the sampling point.
exposed soil	Percentage of naked soil 1 m around the sampling point.
soil litter	Percentage of soil covered by litter (trunks, twigs, leaves, roots) 1 m around the sampling point.

rocky soil	Percentage of rocks covering the soil 1 m around the sampling point.
slope	Maximum slope in a 25 m radius, measured using a clinometer.
altitude	Altitude given by the GPS at the sampling point.
Vegetation composition	Presence of a predetermined list of indicator and easy to identify plant species within a 25 m radius.

Discussion

The Ibis seems to have a preference for dense forests, high canopy cover, in flat areas and with large trees (Margarido 2015). The Ibis seems to be associated with plant species typical of the best preserved forest. The specific composition of these areas provides opportunities for food detection as small invertebrates including snails and slugs in the soil of the forest (Christy & Clarke, 1998), shelter areas and nesting areas. It is normally seen feeding on the ground, on bare soil next to large trees or to rotting logs, and it flies to lower branches nearby once it notices human presence. It seems to be associated to large trees, often with extensive buttresses, which accumulate the bare soil on which it appears to rely for feeding. It seems to be absent from very rocky areas (e.g. at the bottom of cliffs), where it probably can't feed.

Plant composition seems to have significant impact on the presence of Ibis. Their presence appears associated with Mamão-d'Obô *Drypetes glabra*, an endemic plant of the lowland forests of the island of São Tomé, classified as Vulnerable (World Conservation Monitoring Centre, 1998).

Oil Palm *Elaeis guineensis* showed the strongest association with the absence of Ibis. Furthermore, areas with species like the Oil Palm are currently associated with human presence and a certain forest degradation that may explain why the species avoids these locations. Consequently, to preserve the Ibis it is necessary to preserve all the surrounding ecosystem in order to ensure the continuity of the complex relationships on which this species depends.

This study focused on a small area of the Ibis distribution range, during the start of the breeding season. It is therefore key to bear in mind that there are other factors that might determine the occurrence of the species, when looking at other spatial and temporal scales.

There seems to be some seasonal differences in the areas of occurrence, but these are not very clear at present. Impressions from the field team are that they occupy crests and occur in smaller numbers during the dry season, and congregate in flat areas during the rainy season. This makes some sense in terms of breeding and feeding ecology, since they breed during the rainy season and during the dry season there is often a lot of leaf litter, which can make finding food more difficult and force them to disperse. These observations are based on intuitions of the field team and have not been statistically analysed but these impressions are the result of a lot of combined time studying this bird. The field team were excited to witness two Ibis's starting to build a nest, made up of small sticks on a bifurcating branch, providing evidence that the Ibis seems to initiate breeding at the start of the rainy season.

1.3.2. Dwarf Olive Ibis breeding ecology

Discovering more information about CR species ecology is a question of major importance for deciding and directing conservation action. Together with feeding ecology and habitat associations, breeding ecology is one of the most important subjects for being studied and for which we have less answers so far. DOI nests are the easiest to find and probably the most accessible. Besides, this species seems to be the most threatened of extinction in ST, thus the one that most urgently requires further research.

Therefore project team decided to take a first attempt to study DOI breeding ecology. The objective of this trial was to understand the feasibility of studying breeding ecology by following birds on nests, both by recording images with camera traps and by having an observer recording behavior from the ground, also try to record any impact of introduced predators on breeding success and understand how the species would react to human disturbance close to the nest.

This trial was conducted in 2016, starting in October, which is the time of the year when birds are usually seen building nests. We have done an effort to find DOI nests, a field assistant walked around the forests of Ermelinda and Monte Carmo, which are important breeding areas for this species. He was able to find three nests that were being built by that time. First nest was monitored from the ground with field assistant visiting the area three times a week, and noting a clutch of two eggs. However there was a storm with heavy rain and strong wind during November and on the next day the nest was not found on the tree, most probably destroyed during the storm, once it was not built on a strong branch. The second nest started being monitored then with two camera traps placed on the tree, on opposite sides of the nest, one set for taking photos, the other for video recording. The nest was visited once a week to change SD card and batteries. This couple was successful, with two fledged juveniles on December. We have obtained nice footage of nest building and of parents feeding the chicks (Fig. 5). This couple tolerated quite well the cameras placed close to the nest and the regular visits of the field assistants. Both parents seem to participate in nest building and incubation periods as can be seem from the series of photos taken.

Due to logistic constraints and to the fact that no graduate staff was available to supervise and coordinate this study, we were not able to take the most out of this first attempt. However we think there is interest in conducting further studies of DOI breeding ecology, once it seems possible to gather important information without disturbing the species and jeopardizing reproductive success. We believe that with increasing effort, it is possible to find up to 10 nest during a breeding season, which could be followed in a systematic way by field assistants along the breeding season (nest building, incubation, feeding chicks, fledging).

Figure 5- Example of images (photos and videos) of DOI nest captured with camera traps.

1.3.3. São Tomé Fiscal habitat associations study

São Tomé Fiscal

The project worked with a student researcher, Tom Lewis, from the Nottingham Trent University, supporting a study on the habitat associations of the São Tomé Fiscal. The section below has been provided by Tom Lewis.

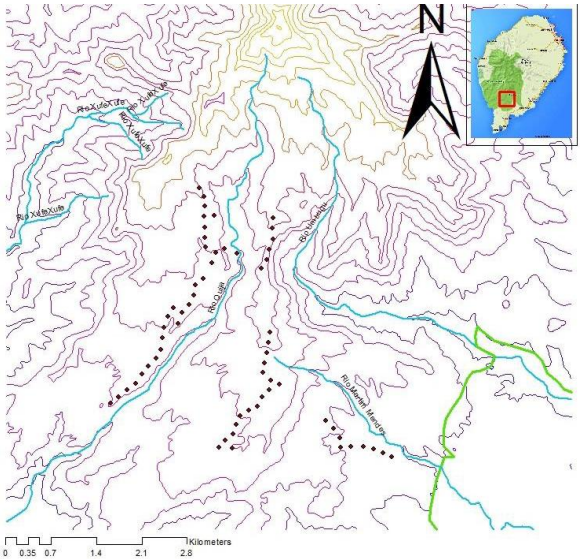


Figure 6- Location of the study area on the island of São Tomé. The transects indicated by black dotted lines.

Methods

The study area was situated in the south west of the island of ST within ONP; it covers about 400 ha of old growth forest in an area of rugged terrain between 200 and 800 metres above sea level (Fig. 6). The topography of the study site is extremely variable; the gentle slope of the lowland forest between 200 and 450 metres in the east is met by a steep escarpment rising to around 600 metres. This escarpment is characterised by its patchy and intermediate forest, with many volcanic ridges and small streams interspersed by small (< 1 ha) flatter areas. The study area is traversed by the Quija River, making accessing half of it difficult. The site is bordered to the north by the mountain Cabumbé, with the western half sloping south-west towards the sea, from the escarpment the ground slopes south-east through the lowland forest and into the oil palm plantations. Surveys were undertaken across 61 point locations and were carried out in the dry season between the 31st of May and 17th of July 2015.

Point counts were positioned along 6 transects walked through the study area, to ensure independence the first point along each transect randomly placed. The coordinates of each point were taken by GPS. The points were between 150 and 200 metres apart, a distance that was considered adequate to avoid double sampling the same areas of forest. Two observers carried out 10 minute point counts, recording the Fiscal within a 25 m radius. Point counts took place between 6:00 and 11:00 and were rotated to ensure the point would be sampled at different times. On arrival at a point an initial 3 minute settling period was used to allow birds to resume normal behaviour. This practice also helps observers identify cryptic individuals so those close to the point can be detected with as much certainty as possible in the dense forest environment (Dallimer and King 2008). Observers underwent a training period to become familiarised with the calls of the Fiscal (Scott *et al.* 1981, Buckland, *et al.* 2001).

Call-backs were played through speakers, after each point count, to confirm if a negative during the point was a true negative. If the Fiscal had been seen during the point count or had responded to a playback at that point previously, playbacks were not used. The response time was measured, if there was a response, to identify birds moving from outside the 25 m radius. Calls were recorded between the 31st of May and 17th of July 2015. When a call was heard the data that was recorded was as follows: time, number of whistles, if there was a reply and type of call (alarm, “normal” or high pitched).

Habitat assessments were carried out in the 25 m radius around each point count location. At the central point, average canopy height was estimated within 5 metre bands. Mid-storey density between 2-5 metres, between 5-10 metres and 10 metres to canopy was estimated, and split into 3 categories (1= open and 3=high density). The number of canopy trees within 25 metres and the amount of epiphytes on a scale from 0-3 (0= none and 3= high density) were also recorded.

At each point, the canopy density was calculated using a convex spherical densiometer with points for each of the four cardinal directions, 5 away metres from the mid-point. Understorey density was also measured by counting number of stems that touched pole in a 1 metre radius 1 metre from the ground. Ferns are known to be associated with moist rainforest environments; research suggests that light conditions created by gaps in forest canopy may be important for fern germination and establishment (Pérez-García, *et al.* 2007). It has been suggested by Olmos and Turshak (2010) that canopy gaps may be an important habitat feature, so as a metric of this the number of ferns within a 5 metre radius of the central point was recorded.

Mist-netting was carried out to capture the Fiscal; each individual was colour ringed so it could be identified, enabling behavioural observations to the individual level. Follows varied in length due to the nature of the terrain making following birds into certain areas impossible. During the follows the information recorded was: behaviour (perching, flying, walking, feeding, calling, and interaction with conspecific), height, length of time, density of vegetation surrounding bird during behaviour. Feeding was recorded as it was observed; time, food item, height of feeding, density of vegetation of feeding and perch height (if used) were recorded.

Results

During the three repeats of the 61 10 minute point counts there were 40 registrations of the Fiscal, corresponding to at least 32 individuals at 28 different points. In addition, another 27 birds were heard during the point counts outside the point count radius of 25 m. Eighteen birds were found incidentally, but there is no way of knowing how many of these birds were already recorded within the counts. Therefore a conservative estimate of the number of Fiscals recorded is 62. Of these 62 birds at least 3 of them were juveniles; 2 had partially moulted into adult plumage, while the third juvenile was in complete juvenile plumage. All three juveniles were found in lowland forest.

In all 115 calls were registered, with an average of 8.84 calls per hour. The highest number of calls came in the 3 hours after sunrise between 5:00am and 8:00am, with a sustained drop between 11:00am and 5:00pm. Results from this study slightly extend the peak for the shrike to 11:00am; after this time there is only a small amount of activity until 5:00pm and a dusk peak. The results also suggest that surveying in

the afternoon would not be advisable as the activity peak is short and very close to sunset. The calls of the Fiscal are very distinct; a repeated whistle that is of a higher pitch when heard from further away (Christy and Clarke 1998). In densely vegetated forest environments a large proportion of the registrations during bird surveys are likely to be solely auditory (Scott *et al.* 1981, Emlen *et al.* 1989, Simons, *et al.* 2007), so establishing if the call activity pattern is similar to that expected could help inform future surveys focusing on the Fiscal. They have three distinct calls, but only two had been previously described (Christy and Clarke 1998), the third higher pitch call seems to be in response to an intrusion rather than being warped by the topography. The birds are very responsive to call-backs and are likely to approach to within 10m, allowing for easy identification of either colour-ringed individuals or juveniles.

The variables that have the strongest support in predicting presence using the count data are elevation and midstorey density between 2 and 5 metres.

Discussion

Feeding ecology and habitat associations

The dietary composition of the Fiscal is not known and only two feeding observations were made during this study; in both cases these involved invertebrates. Christy and Clarke (2008) observed the Fiscal taking insects both on the ground and in vegetation; therefore it seems that invertebrates make up a large proportion of its diet. Studies have found that invertebrate species diversity increases at intermediate altitudes (Brehm *et al.* 2007, Wronski, *et al.* 2014). Mid-elevations have a more stable climate with the highest humidity and moderate temperatures (Kluge *et al.* 2006). This means more favourable conditions for taxa such as epiphytic plants, and creates microhabitats for invertebrate fauna (Rahbek 1995). Coupled with elevation there is a negative relationship between high density midstorey (between 2m-5m) and presence of the Fiscal. This supports the statement by Christy and Clarke (1998) that this species prefers to perch between 3m-5m to scan for prey.

Study results however contradict their claim that it selects open understorey with little vegetation; this study found no relationship between understorey density and presence of the species. Christy and Clark (1998) descriptions were based on non-systematic observational notes on the habits and behaviour of the Fiscal with only a few birds observed. Therefore suggestions of habitat associations were likely biased towards areas in which it is more easily observed. Selection against areas of dense midstorey makes sense for a shrike, whose foraging behaviour relies on perching and scanning for prey. This indicates that even though the Fiscal is a forest dwelling bird, it has not greatly altered its foraging behaviour. Instead, it has adapted to take advantage of microhabitats within the forest environment that are similar to those its ancestors and now sister species *L. mackinnoni* exploit on the mainland (Harris 2010).

Being closely related to the forest edge specialist *L. mackinnoni* (Fuchs *et al.* 2011), it might be expected that the Fiscal is not a bird of closed canopy forest as suggested by Christy and Clarke (1998). The negative relationship between canopy density and presence of the Fiscal supports this assumption. Olmos and Turshak (2010) suggest that their distribution is linked to water courses; results from this

study indicate that it might be lower density forest canopy, usually found above a water course (*pers. obvs.*), that is more important than the water course itself.

The level of plant species diversity in tropical forests has been shown to be promoted by forest gaps created by tree falls (Schnitzer and Carson 2001). More generally decreased canopy density allows more light to penetrate to the forest floor creating conditions for forest gap species such as ferns to become established (Pérez-García, *et al.* 2007), creating microhabitats for other taxa (Rahbek 1995). In certain areas across the study site there are extremely shallow soils (*pers. obvs*.), which could prevent large canopy trees establishing, providing an alternative mechanism for maintaining forest gaps and giving other smaller plants space to establish. Forest gaps or areas of lower canopy density may help promote high native plant diversity, which is known to reflect high invertebrate diversity (Crisp *et al.* 1998). Although plant diversity was not measured in this study, it might be expected that more heterogeneous montane forest would hold higher plant diversity and areas of lower canopy density would allow more light into the midstorey, aiding the identification of prey.

Nevertheless results indicate that in most areas surveyed the Fiscal distribution is patchy, possibly mirroring the patchiness of high quality habitat. Detections in the south-east of the study site were grouped and detached; the only area in which detections were consistently made within the point counts was to the north of the study area, suggesting these areas are of better quality.

A potentially concerning finding of this study is that the Fiscal was not found in the lowland forests in the east of the study site. This area was not extensively surveyed, but it was previously described as a key area for the species (Olmos and Turshak, 2010 and Jones and Tye, 2006). The fact that it was not found here at all in this study suggests a recent reduction in range, which may be to the result of deforestation around the boundary of the ONP in the last five years, and its effects on the adjacent forest or it could be as a result of the impact of introduced species, such as the Mona Monkey *Cercopithecus mona* and the Black Rat *Rattus rattus*. Establishing the sensitivity of the species to edge effects and invasive species could provide vital information for the future conservation of the species and, coupled with research into its diet, will help inform decisions regarding the future sustainable management of the forests of ST.

The Fiscal was, until recently, considered to be a lowland forest bird with most of records coming from forests at altitudes under 300m (Atkinson *et al.* 1991, Sergeant 1994, Schollaert and Willem 2001). More contemporary records have far extended its known range; with its altitudinal limit now 1345 metres (Maia and Alberto 2009). The lowest record of shrike was at 100m in 1997, in lowland forest around Rio Martim Mendes, southeast of São Tomé (S. d'Assis Lima *in litt*.). Even though they were found historically in lowland areas apparently accessible to locals, it was unknown to Portuguese residents who were shown specimens by the collector José Correia (Correia 1928-1929b in Jones and Tye, 2006) or more recently hunters at Santo António de Mussacavú and Santa Catarina (Atkinson *et al.* 1991). This suggests that it has never been a common bird in lowland areas. Taken together, the historical and contemporary records indicate the Fiscal is capable of existing across a range of forest types and has a large altitudinal range. The historical range of the species was most likely from the lowland forest in the south and southeast to the high altitudes in the mist forest in the central massif and throughout the forest to the south and west, now within ONP. Recent surveys have not found any Fiscal next to Rio Martim Mendes (de Lima *per comms*), indicating that its numbers may have declined within the last 20 years.

Breeding biology and juvenile dispersal

Three juvenile sightings were made during this study, all of which occurred within typical lowland type forest; high gallery canopy and dense understorey. Two of these juveniles had partial adult plumage, whereas the third had full juvenile plumage. This suggests that the first two were between 5 to 11 months old and were moulting into their adult plumage (Chapman 1995, Melo pers. comms). Although the moult timings of the Fiscal are not known exactly, using moulting patterns from *L. collaris* suggests that the third juvenile is most probably a fledgling from between April and July (Chapman 1995). Birds in full juvenile plumage had previously only been found in January (Melo *pers. comms*); combining this information indicates that the Fiscal breeds from November to July. Other shrikes that inhabit wet areas on mainland Africa have year-round breeding seasons (Marshall and Cooper 1969), so it is quite possible this is also the case with the São Tomé Fiscal. To confirm this, surveys should be carried out throughout the year to try and identify any peaks in the number of juveniles seen.

Even though the study only found three juveniles, the fact that they were all in areas of perceived low quality habitat suggests that they may be forced out of their natal areas into these lower quality areas. If this is the case it is extremely encouraging, as it indicates that high quality habitat is already at saturation. Therefore, as long as juvenile survival and recruitment into the population is good the population is healthy. The species breeding biology needs further research, but observing juveniles of a CR species whilst spending a relatively short period of time in the field and outside the described breeding season is extremely positive.

This study highlights the needs for further research on the São Tomé Fiscal, because as the human population on ST increases and commercial activities at the borders of ONP intensify, it is of vital importance the impacts on the Fiscal and the other endangered species are understood.

1.3.4. São Tomé Grosbeak

Despite the many new records, the Grosbeak remains the least seen and most mysterious of São Tomé endemic bird species, which might be due to its discreteness and not necessarily only due to its scarceness. Survey work confirmed the presence of the Grosbeak in new locations and at different altitudes. New findings for the species also included recording the species outside the ONP and in secondary habitats near native forest (Solé *et al.* 2012). These observations suggest that this species might be much more widespread and numerous than what it was previously thought (Jones and Tye 2006). Habitat degradation has also been listed as a key threat to its survival (Ndang'ang'a *at al.* 2014), but this might not be as important, since the species is now known to use secondary habitats and to feed on plants typical from degraded areas. It is now being proposed that this species might hybridise with the very closely related São Tomé Seedeater *Serinus rufobrunneus thomensis* (Stervander 2015), and even though this situation requires further clarification, it might pose an additional threat to its conservation.

1.4. Distribution information for species of special interest

It was important to maximise the opportunity presented through survey work, due to the lack of existing comprehensive survey effort for the island. Therefore we widened our taxonomic focus and made additional records of other species (Table 4). We mapped the distribution of selected species of interest (Figs. 7-10). Four observations were made of the Endangered shrew *Crocidura thomensis*, and these have been included in a manuscript, accepted for publication in Oryx, titled "Reassessing the distribution, ecology and conservation status of *Crocidura thomensis*, endemic to São Tomé Island (Gulf of Guinea, central Africa)". Later, in 2016, two other observations of shrew were obtained during our works, in Monte Carmo and Ermelinda.

Table 4 - Species included within survey and the rationale

Taxa	**Reason of interest**
Point counts (complete list in Portuguese in c3.doc)	
All birds and bats	-
Monkey, pig, civet, weasel, cat, dog, rodents	Invasive
São Tomé shrew	Scarce threatened endemic
Humans	Potential threat (list activity)
All amphibians (adults and tadpoles, visual and aural)	Endemic, some threatened and distribution poorly known
All reptiles	Some endemic, some threatened, black mamba invasive and poorly known distribution
Introduced giant land snail	Invasive
Endemic giant land snail	Threatened endemic
Atopocochlis exarata	Endemic with poorly known distribution
124 selected plant species	30 endemic, others invasive, food, indicator, little known, threatened
Ad-hoc records (complete list in Portuguese below)	
Dwarf Olive Ibis, São Tomé Fiscal and Grosbeak	CR endemic
Maroon Pigeon, São Tomé Scops Owl, Short-tail and Giant Sunbird	Scarce and threatened endemic
Grey Parrot	Scarce and threatened
Storm Petrel	Potential new species
Barn Owl	Little recorded endemic subspecies
Introduced mammals (pig, cat, civet, rat, mouse, weasel, dog or any domestic, feral or wild)	Most invasive and strong potential to disturb island ecosystems
Bats	Poorly known distribution
Large endemic land snails	2 endemic species
15 selected plant species	Endemic, exotic, poorly recorded, threatened

1.4.1 Giant Land snails

The invasive African Giant Land Snail *Archachatina marginata* was concentrated in the lower altitude parts of the protected area, predominantly to the east and south of the buffer zone, while the endemic Gulf of Guinea Giant Land Snail *Archachatina bicarinata* was mostly found inside the ONP and in inaccessible areas (Fig. 7). Both species are collected as food by local people and there were far fewer records of the endemic species, causing concern for its conservation status.

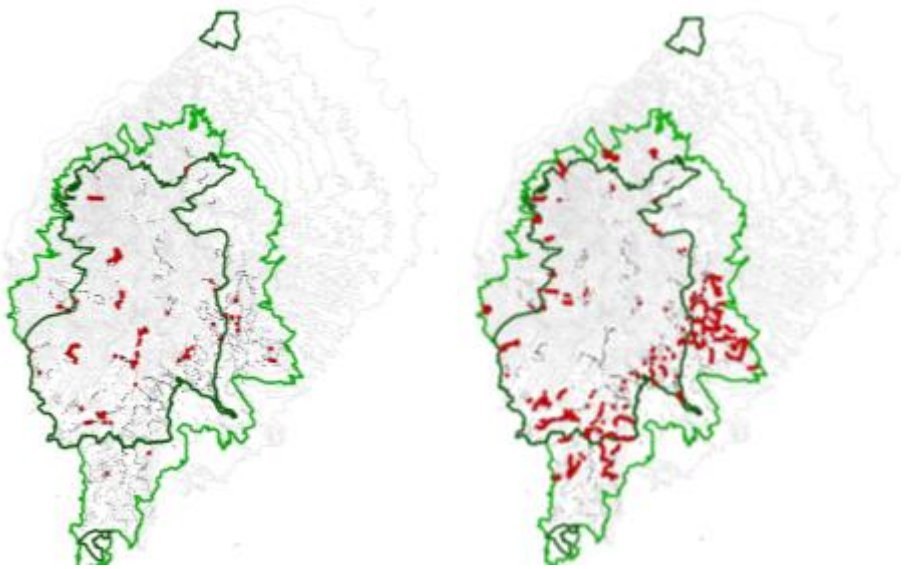


Figure 7 – Map of São Tomé , with the green lines indicating Obô Natural Park boundaries (darker green = core park, lighter colour = buffer zone). Background black lines are 50m altitudinal isohyets. Red dots indicating records of the endemic giant land snail (left) and Invasive giant land snail (right)

1.4.2. Endemic plant species

A larger number of records of endemic plant species has been collected, which will contribute to improving knowledge and understanding of botanical diversity and ecology of São Tomé's forests. The data on trees are being assessed with the Global Tree IUCN Specialist Group, in order to enable a review of their conservation status. Of the 15 indicator plant species, 4 of the endemic/threatened species are presented here in Figure 8. The distributions of all 4 species are fairly wide within the protected area, seemingly with fewer records to the southwest.

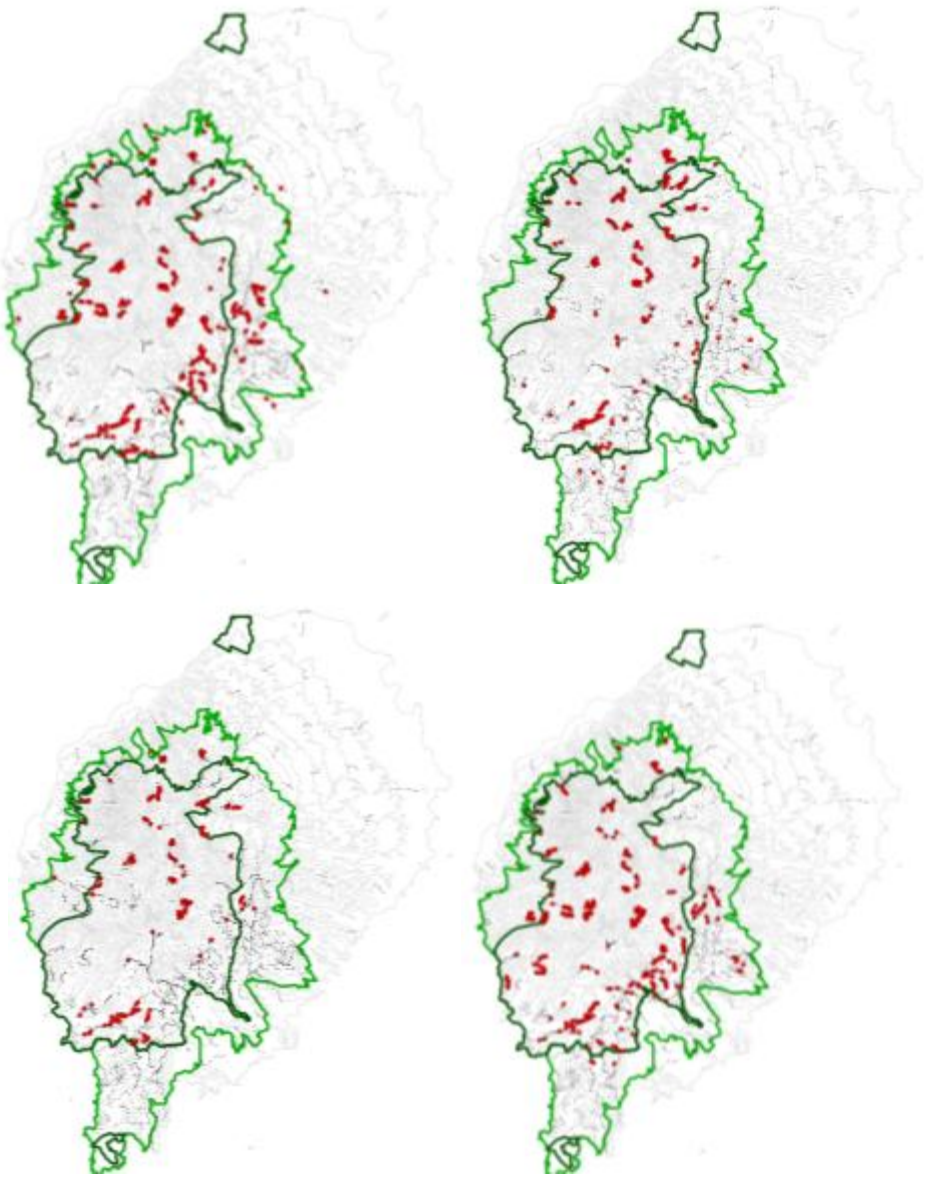


Figure 8 - Map of São Tomé , with the green lines indicating Obô Natural Park boundaries (darker green = core park, lighter colour = buffer zone). Background black lines are 50m altitudinal isohyets. Red dots indicating records of the *Carapa gogo* (top left) *Croton stellulifer* (top right) *Polyscias quintasii* (bottom left) *Staudtia petrocarpa* (bottom right)

1.4.3. Invasive plants

Distribution maps for 4 invasive plants are included here with many records for the *Elaeis guineensis* and *Pycnanthus angolensis*, predominating along with southeastern area of the protected area. All species have fewer records and less distribution inside the central area of the ONP (Fig. 9).

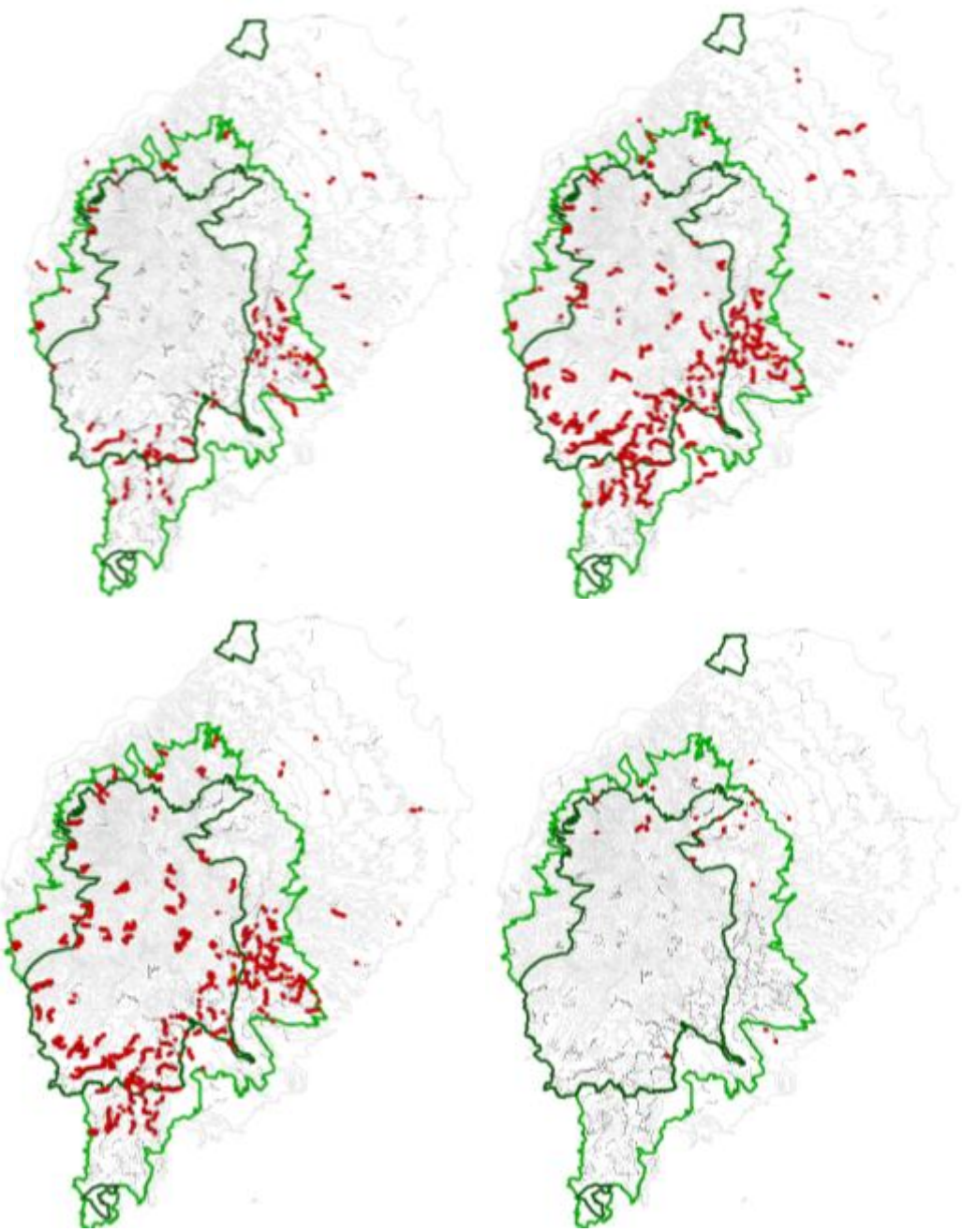


Figure 9 - Map of São Tomé , with the green lines indicating Obô Natural Park boundaries (darker green = core park, lighter colour = buffer zone). Background black lines are 50m altitudinal isohyets. Red dots indicating records of the *Artocarpus altilis* (top left) *Elaeis guineensis* (top right) *Pycnanthus angolensis* (bottom left) *Persea americana* (bottom right)

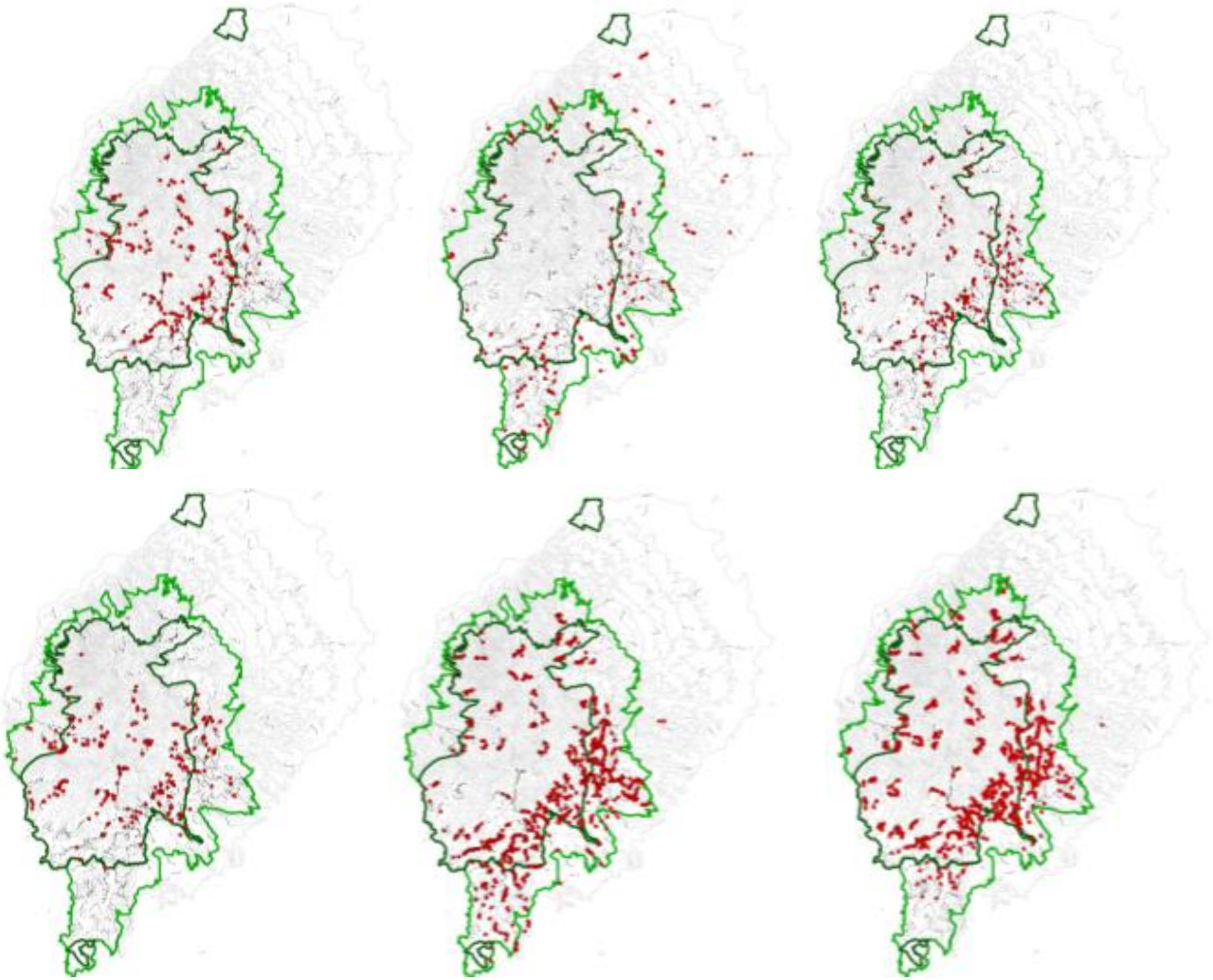


Figure 10 – Distribution of selected species of São Tomé endemic birds, from top left to bottom right: Giant Sunbird *Dreptes thomensis*, Giant Weaver *Ploceus grandis*, São Tomé Scops Owl *Otus hartlaubi*, São Tomé Short-tail *Amaurocichla bocagei*, São Tomé Green Pigeon *Treron sanctithomae* and São Tomé Oriole *Oriolus crassirostris*. The green lines indicating the boundaries of the Obô Natural Park boundaries (darker green = core park, lighter colour = buffer zone). Background black lines are 50m altitudinal isohyets. Red dots indicating records of the species.

1.4.4. Endemic bird distributions

We also mapped the distribution of other ST endemic birds (Fig. 10). The Giant Weaver *Ploceus grandis* is unusual in that it was recorded mostly outside the protected area and was not associated with tropical forest habitat. The São Tomé Green Pigeon *Treron sanctithomae* and Oriole *Oriolus crassirostris* were frequent throughout the forest habitats. The Giant Sunbird *Dreptes thomensis*, São Tomé Scops Owl *Otus hartlaubi* and Short-tail *Amaurocichla bocagei* were, to varying degrees, more restricted to the interior of the ONP and surrounding areas with well preserved forests.

1.5. São Tomé Giant Tree Frog habitat associations

São Tomé Giant Tree Frog

The project worked with a student researcher, Lena Strauss, from Humboldt University of Berlin, supporting a study on the habitat associations of the São Tomé Giant Tree Frog. The section below has been provided by Lena Strauss.

Two tree frog species occur on São Tomé. *H. molleri* is light green on the back and red or white on the belly. Males emit clack sounds when calling. Eggs are deposited on leaves over stagnant or slow-moving water, into which larvae drop once hatched (Drewes & Stoelting 2004). *H. thomensis* is dark green or brown on the dorsum, bright orange and white with dark spots on the venter (Schiotz 1999). It can be up to 50 % larger (males: 27-41 mm, females: 36-49 mm). The advertisement call of *H. thomensis*, a creaking buzz, is lower in frequency than that of *H. molleri* (Schiotz 1999). Reproduction takes place in phytotelmata, water-filled tree holes (Drewes & Stoelting 2004).

Methods

Four land use categories were selected: primary forest (PF), secondary forest (SF), shade plantation (SP), and garden cultivation (GC). The **primary forest** is the natural mountain rainforest with Rubiaceae, Euphorbiaceae, and different epiphyte types as the dominant vegetation. The steep terrain keeps human influence low. About 85 % of São Tomé 's primary forest is comprised by the ONP. Typically,

the primary vegetation is buffered by **secondary forest**. This successional forest type evolves after tree extraction or abandonment of shade plantation and typically features many non-endemics with low-quality wood (de Lima et al. 2013). **Shade plantation** is a managed agroforestry system (Tscharntke et al. 2011). The small, perennial coffee trees (*Coffea* spp.) are shaded by over-storey trees (Salgueiro & Carvalho 2002). These contribute to soil amelioration, pest control, and improved coffee quality (Tscharntke et al. 2011). The introduced, fast-growing, and nitrogen-fixing Coral Tree (*Erythrina* spp.) is a very common shade tree species. Secondary forest and shade plantation are increasingly cleared for **garden cultivation**, to grow annual crops such as cabbage, tomato, and carrot. These are increasingly located on steep slopes due to the scarcity of available terrain. Tree cover is mostly absent, with the occasional isolated tree.

Eight random points per land use category were selected, ensuring water body availability in close vicinity (maximum distance: 150 m). In this procedure 32 transects (8 x 4) were established, six of those, however, were devoid of water. Each transect was 100 m long and at least 100 m apart. Each transect was visited three times, which resulted in 96 transect walks (3 x 32). Acoustic data (up to 30 m to each side of the transect) was taken from anuran male advertisement calls. Males intending to attract females can be reliable indicators of reproduction sites. Individuals were identified through allocating perceived call sequences to the same direction and distance. Visual data (up to 2 m to each side of the transect) comprised all sexes and developmental stages, including eggs, tadpoles, juveniles, and adults.

Results

Regarding *H. molleri,* the largest differences in abundance occurred between shade plantation with almost no individuals (1) and secondary forest with the most (33). The latter was closely followed in numbers by garden cultivation (32). Abundance in primary forest was low (6). Individuals of *H. thomensis* were nearly only counted in shade plantation (23), with a few exceptional findings in secondary forest (3). Thus, differences between shade plantation and each of the other three land use types were all significant for this species (Fig. 11).

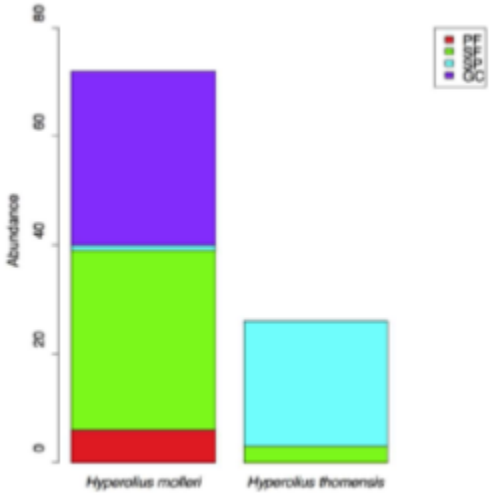


Figure 11 – Acoustically recorded amphibian species on 96 transect walks along 32 transects; species abundance in primary forest (PF), secondary forest (SF), shade plantation (SP), and garden cultivation (GC) represented by a counts-based stacked barplot.

Habitat associations

H. molleri was present in all land uses. It appeared to be a habitat generalist, as described in the literature (Drewes & Stoelting 2004; IUCN SSC Amphibian Specialist Group 2013). Abundances depended upon land use and thereby most likely on canopy volume and plant species composition. The presence of stagnant or running water or both was also influential. Yet, abundances varied between land use types being highest in secondary forest. *H. thomensis w*as a habitat specialist, because its abundance was nearly limited to shade plantation. Abundances significantly depended on having high number tree hole, namely those in Coral Trees.

These results contradict the literature on *H. thomensis*, according to which it should only occur in primary forest. It is important to note a caveat to this finding, in that detectability could be far more complicated in primary forest and result in lower numbers of encounters than in shade plantation, which is easier to access. However, finding the species in shade plantations is a significant finding and expands scientific understanding on the species as previously considered a primary forest specialist.

The difference in habitat preference between the species could be related to their different reproduction modes: *H. molleri* breeds at open waters and *H. thomensis* in phytotelmata. *H. molleri* needs to find two microhabitats in close proximity: leaves for oviposition and water reservoirs for larval development, artificial water bodies can serve both purposes, as eggs can be attached to their inner walls. For *H. thomensis*, water-filled tree holes are crucial for reproduction, as both egg and larval development take place inside of them (Drewes & Stoelting 2004). The change in tree hole availability along the land use gradient was not gradual, but abrupt, which produced a non-significant effect of the gradient as a whole. Shade plantations consistently harboured phytotelmata, in contrast to the other three land use types. This is possibly because the mono-structure of a handful of shade tree species, which are typically fast-growing, but prone to develop tree holes. Encounters of *H. thomensis* in primary forest, as observed in the cited literature, and in secondary forest, might be therefore exceptional. The independence from land use may also be explained by the phytotelmata being “a self-contained microcosm” (Lehtinen et al. 2004). Temperature is kept at a stable level inside this microhabitat, relatively independent of the macroclimate (Stokland et al. 2012). If suitable phytotelmata are present, other landscape parameters are fairly irrelevant. Yet, tree holes are strongly associated with shade plantations, which highlights the conservation potential of this land use type.

H. molleri should find a greater variety of suitable vegetation in primary and secondary forest, since plants are more diverse and abundant. Possibly leaf size and leaf height play a role, for static and microclimatic reasons, respectively. Yet, primary forest may not offer adequate water resources, because the steep terrain favours fast-running rivers. The optimal combination of microstructures appeared to exist in secondary forest, where roads with puddles are often framed by overhanging vegetation. In garden cultivation, artificial cisterns, including ponds and rain barrels, frequently served as *H. molleri* reproduction sites. Shade plantation lacked suitable microhabitats, because this agroforestry system typically has few water bodies available.

Furthermore, *H. molleri* is much more exposed to external factors, which change between land use types, than *H. thomensis*. Sunlight guarantees warm air temperature and thus fast growth and developmental rates of offspring – paramount factors at ephemeral waters (Blaustein & Belden 2003;

Bancrft et al. 2008). The dense primary forest rarely offered canopy gaps, in contrast to secondary forest. Garden cultivation, the most modified habitat, acquired most solar radiation. Interestingly, *H. molleri* avoided high maximum air temperatures, despite being able to cope with hot climate in the lowlands.

The pressure from resource use will only increase on São Tomé, due to the foreseeable growth of the human population and of the export sector for agricultural crops. Intensification may thus occur in all land use types, jeopardising habitats of *Hyperolius* spp. Primary forest, secondary forest, and shaded plantation are all currently being replaced by garden cultivation (de Lima et al. 2013), while shade plantation and garden cultivation may overall be moved to higher altitudes due to climate change. Consequently, forested areas will decrease, affecting primarily *H. thomensis*. The conservation of trees with holes should be prioritised, as *H. thomensis* is more endangered than *H. molleri* and shade plantations are more valuable for biodiversity protection than garden cultivations.

Hybridisation has been identified as a potential threat to the status of *H. thomensis,* with evidence of the species interbreeding with the less threatened and more abundant *H. molleri.* The different habitat preferences of the species appears to mean that the impact of this problem could therefore be lower and restricted to areas of overlap in garden cultivation. Nevertheless, this threat is difficult to unravel and requires further research.

1.6. Data management and access

The Government are funding and developing a national environment observatory, an open access environmental database, collating all the existing national data on biodiversity and enabling access. Data collected from our study are a key part of this and will be included within the database with certain permissions in place on sensitive data. This is a great initiative of the Government, and it is important that data from this project can be incorporated and comparison enabled with other data on forests and communities. This resource will provide the Government with essential information for underpinning land-use management and decision-making. The project partners will be partners in this initiative and a data use agreement established.

1.7 Promotion of science outputs

The outputs from this work have been written up as a paper for Bird Conservation International entitled *Distribution and habitat associations of the critically endangered bird species of São Tomé Island (Gulf of Guinea).* This has been translated also into Portuguese and shared with national stakeholders and local staff. The excerpt of the summary from this paper is included here:

São Tomé holds 20 endemic bird species, including the little known and 'Critically Endangered' Dwarf Olive Ibis *Bostrychia bocagei* , São Tomé Fiscal *Lanius newtoni* and São Tomé Grosbeak *Neospiza concolor* . We conducted a systematic survey of the core forest area, performing 1,680 point counts and compiling occasional observations, which enabled the identification of new areas of occurrence for the target species. MaxEnt distribution modelling suggested that the ibis and fiscal have roughly half of the

potential area of occurrence that had been assumed (127 and 117 km 2 , respectively), while it more than doubled that of the grosbeak (187 km 2). The south-west central
region of the island, most of which is included in the São Tomé Obô Natural Park, has the highest potential for the Critically Endangered birds. We confirmed the association of all target species with native forest. The ibis preferred high tree density, while the fiscal selected low tree density and intermediate altitudes. Despite very restricted ranges, population sizes seem to be larger than previously assumed. These results suggest that the fiscal and grosbeak might be better classified as 'Endangered', while the ibis should maintain its status under different criteria, due to a very restricted range during the breeding season. This work provides vital ecological knowledge to support conservation action focusing on these species and their habitats, highlighting the need to improve the effectiveness of the São Tomé Obô Natural Park in protecting its unique biodiversity.

Objective 2: Species conservation accounts and action plans are updated for three Critically Endangered species to inform conservation solutions, including in Obô Natural Park.

2.1 Threat assessment and forest monitoring

The ONP and buffer areas have been found to encompass the majority of the most important forest habitat, and thus all of the 3 CR birds populations are encompassed within this area, together with significant proportions of other globally threatened endemic forest biodiversity. A key obstacle for the enforcement of the ONP is the limited budget currently available for implementation of critical actions, including surveillance and monitoring. Furthermore ST population is growing, with a considerable amount of people still surviving based on subsistence economic activities which rely mostly on natural resources, with pressure over those increasing substantially. This, in conjunction with agricultural developments underway in the buffer zone, is opening up sensitive areas of the park and facilitating widespread unsustainable extraction of forest resources and localized forest conversion to agriculture.

Methods

Threat assessment methodology was developed in order to evaluate human activity around the borders of the ONP and to understand how it may be impacting the forest and its threatened biodiversity. The purpose of this work was to trial an approach to developing a surveillance and enforcement protocol for the ONP that could be rolled out more widely to increase the enforcement presence for protection of this protected area. Objectives were to:

- increase knowledge of the variety and level of threats impacting on high conservation value areas,
- collect information to enable targeted conservation responses to threats and inform stakeholders
- map and quantify threats

Figure 12 – Distribution of transects to monitor threats and biodiversity in São Tomé forests. The green line indicating Obô Natural Park, yellow line indicating buffer zone.

Table 5 - Transects selected for forest and biodiversity monitoring, length walked per season, medium altitude and habitat.

	Number of sections		Altitude	Habitat (number of sections)			
	Fev/Mar	Oct/Nov	(medium)	Capoeira	Obo	Agriculture	
AguaJoao-Rosario	40	35	298	23	15	2	Cocoa
BomSucesso-Chamico	82	83	1169	19	62	2	Varied
ClaudinoFaro-DuasGrotas	40	44	498	14	28	2	Varied
DoisIrmaos	24	20	277	7	17	0	-
DonaEugenia-AguaFerro	31	31	110	11	18	2	Oil palm
Ermelinda-VilaVerde	40	40	296	38	0	2	Oil palm
FormosoPequeno	37	35	611	15	20	2	Cocoa
Macambrara	40	40	1374	0	37	3	Varied
MonteCarmo-TiraFome	40	40	378	0	38	2	Oil palm
Mulundo	13	13	578	6	5	2	Abandoned
Quija-MonteRosa	40	40	202	20	20	0	-
Rebordelo	28	26	897	22	5	1	Varied
RioAve	14	25	389	23	0	2	Varied
SantaJenny	37	34	699	13	21	3	Cocoa
SaoJoao	42	42	440	28	12	2	Cocoa
SaoJose	33	25	215	27	4	2	Pepper
SaoMiguel-Zagaia	40	25	45	27	13	0	-
Tras-os-Montes	40	40	939	28	12	0	-
Total	**661**	**638**		**321**	**327**	**29**	

Transects were selected from existing regularly used trails that constitute main entrances to the ONP, meeting the criteria of being accessible and repeatable for being included in a future monitoring protocol. After a first trial with 22 transects of 2 km patrolled in August 2015, we have decided to enlarge the transects in order to comprise areas with better forest and enable us to perceive a clear gradient of forest quality and human pressure along the transects, when entering farther inside the forest. Finally we were able to select 18 transects for being repeated regularly (Fig. 12). Those were patrolled twice during 2016, on foot and by two field assistants, first from 5th February to 18th March, second time from 7th October to 10th November, between 6:15 am and 17:10 pm. Transect length varied between 1300 and 8300 m (Table 5) according to the length and usage of the trail that was being monitored. Some transects could not be completed in one of the seasons, mostly because of heavy rain. Number of sections monitored for each transect and season is shown on Table 5.

Data was recorded for each 100m section, where a GPS point was taken. First 200m were always done before entering the forest which would start exactly at the beginning of the third section. This enables to characterize land use and activities developed in the vicinity of the forested area. One field assistant was responsible for collecting data on plant species (presence/absence and abundance on a scale of 1-5 from a list of 30 pre-selected species, which consisted of species that were either invasive, threatened, indicators of non-disturbed areas or important for house building) while the other would do general characterization and collect data on other *taxa*, including signs of human presence (elevation, habitat, canopy cover and height, slope, weather; number of individuals of a pre-selected listed of birds species; presence of mammal, giant snail, reptile and amphibian species; signs of human activities and encounters with people).

Results

Species

Along the transects, we obtained 28 records of CR species, mostly Ibis. This species was found in six transects and signs of its presence were also found in another one. In Dois Irmãos there were found two old nests and one feather. In Formoso Pequeno and in Claudino Faro-Duas Grotas, this species was found in areas where its presence had not been confirmed during other surveys. There was also one interesting record of Fiscal, in Claudino Faro-Duas Grotas, again in one area where it had not been recorded for some years. The Grosbeak is very difficult to find, therefore it is relevant to have eight new records. There were also recorded 167 birds of other threatened species (Table 6, Fig. 13-14).

Some transects look particularly important regarding the species that were recorded there. Claudino Faro-Duas Grotas hosts the 3 CR and the other threatened species. Dois Irmãos, only 2400 m long, had records of Fiscal and other four threatened species. Additionally the Ibis and the Grosbeak have already been recorded in that area, but not sighted in 2016. Dona Eugénia-Água Ferro, Monte Carmo-Tira Fome, Quija-Monte Rosa and São Miguel-Zagaia also have important numbers of CR species and other threatened birds. Finally, Formoso Pequeno hosts two CR birds and many records of other endangered species.

Table 6 - Threatened birds recorded along the transects.

	Threatened birds					CR birds			
	Pigeon	Shorttail	G.Sunbird	Scops-owl	Total	Ibis	Fiscal	Grosbeak	Total
AguaJoao-Rosario				6	**6**	2			**2**
BomSucesso-Chamico	9		1	7	**17**				
ClaudinoFaro-DuasGrotas	3	8	5	2	**18**	2	1	4	**7**
DoisIrmaos	3	1	1	1	**6**	signs	1		**1**
DonaEugenia-AguaFerro	1	4	2	6	**13**	2			**2**
Ermelinda-VilaVerde		1		1	**2**	3			**3**
FormosoPequeno		7	6	2	**15**	2		1	**3**
Macambrara	2		1	1	**4**				
MonteCarmo-TiraFome	1	3	6	2	**12**	5		1	**6**
Mulundo	2		1	2	**5**				
Quija-MonteRosa	2	1	2	1	**6**		2		**2**
Rebordelo	8			3	**11**				
RioAve				1	**1**				
SantaJenny	1				**1**				
SaoJoao	1		1	7	**9**				
SaoJose		2			**2**				
SaoMiguel-Zagaia	6	3	2	1	**12**			2	**2**
Tras-os-Montes	15		5	7	**27**				
	54	**30**	**33**	**50**	**167**	**16**	**4**	**8**	**28**

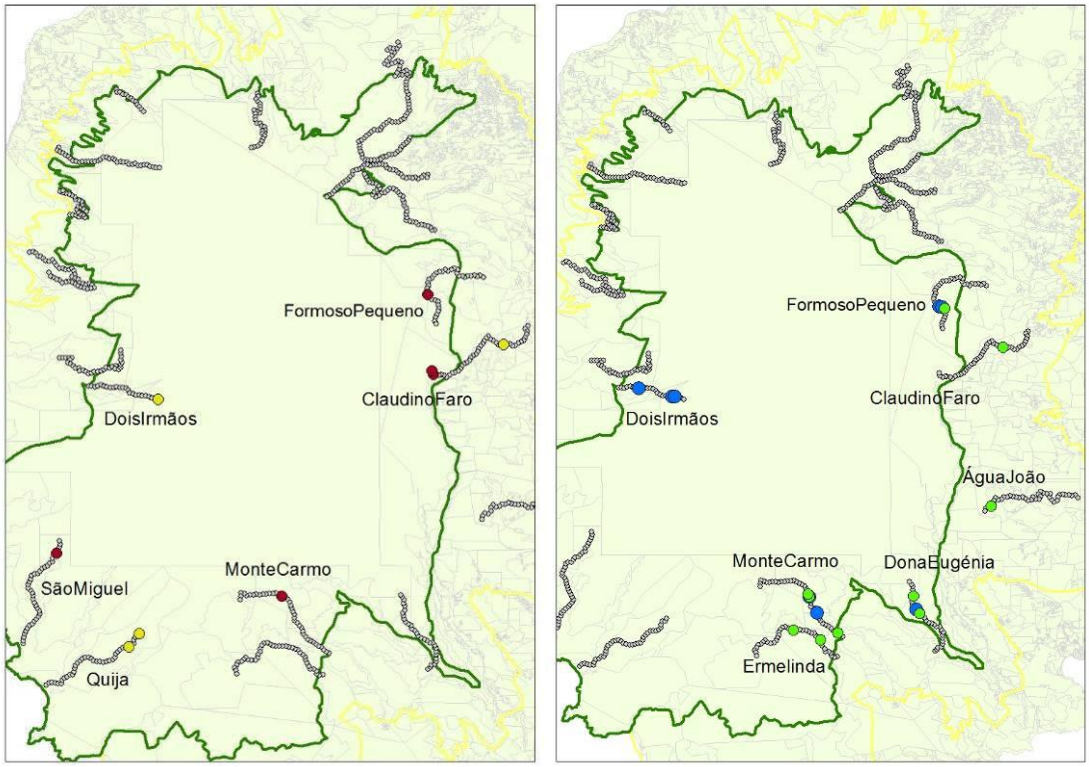


Figure 13 – Records of CR species: left side, yellow records are for the São Tomé Fiscal and red records for the São Tomé Grosbeak; right side, green records are for the Dwarf Olive Ibis, with signs of its presence (old nests, feces or feathers) represented in blue. The green line indicating Obô Natural Park, yellow line indicating buffer zone.

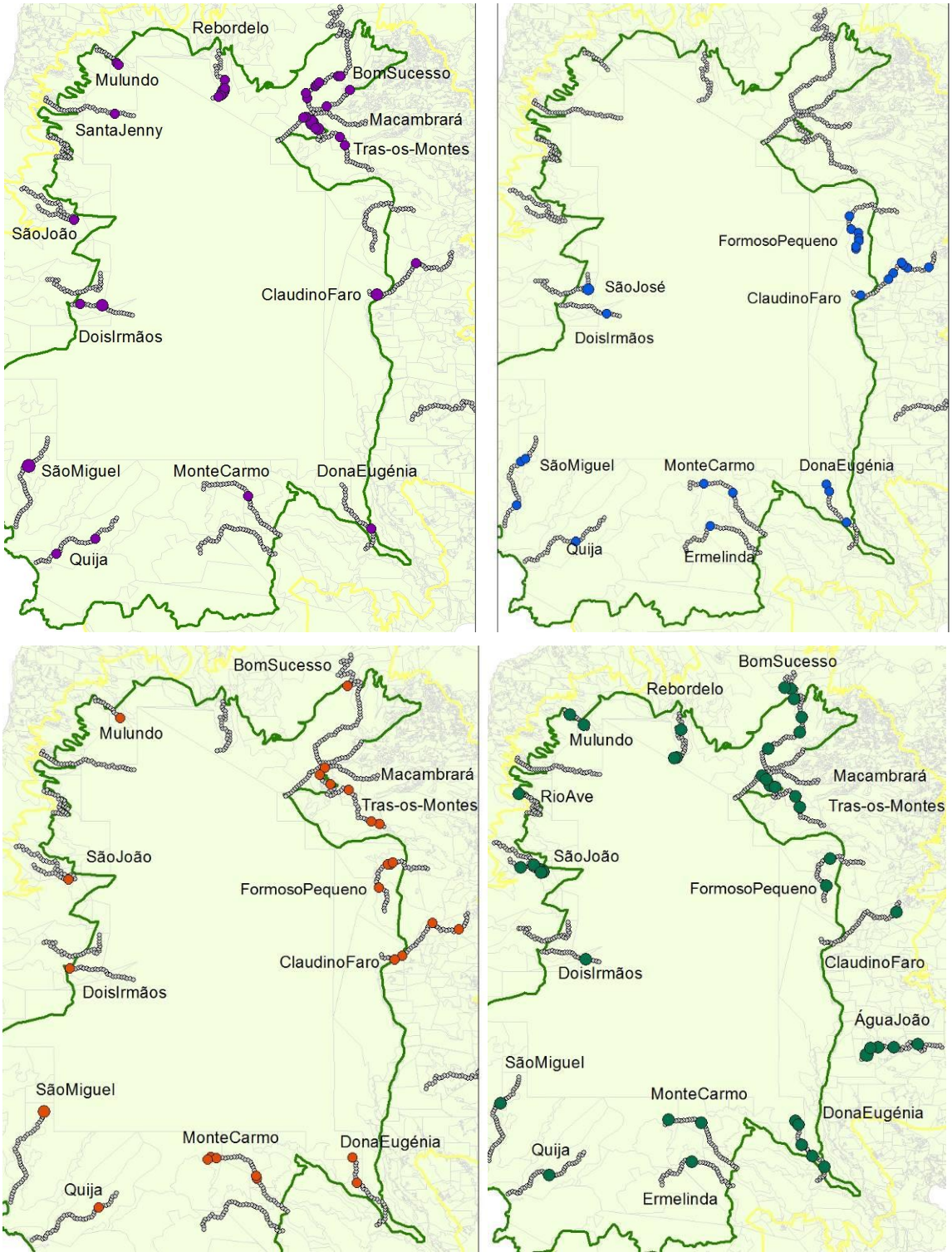


Figure 14 – Records of other threatened bird species: top left, purple records are for the São Tomé Olive Pigeon *Columba thomensis*; top right, blue records are for the São Tomé Short-tail; bottom left, orange records are for the Giant Sunbird, and bottom right, green records are for the São Tomé Scops Owl. The green line indicating Obô Natural Park, yellow line indicating buffer zone.

Human activities

All signs of human presence and extractive activities along the transects were recorded, of which Giant Snail gathering, logging, hunting, tapping and collection of barks from trees are the main activities being developed inside the forest area (Table 7). Snail gathering, logging and tapping are more prevalent in the first 2 km of transect and almost do not occur after 3000 m. Records of logging further than this were all from Bom Sucesso-Chamiço and São João, transects that do not go straight to the centre of the forest area and which have other entrances. Hunting and bark collection are activities practiced along all the distance of the transects.

People found during the transects also decreased along the distance travelled. Most people were found in the first 1000 m, and 38 were actually found outside the forest, in the first 200 m. More than half were related to palm-wine extraction, 10 were either tourists or guides and 9 were farmers (Table 8 and fig. 15). Formoso Pequeno was the transect where more people were found, specially tapping or carrying palm wine in containers.

It may be important to point out that during the first trial in 2015, when a total of 79 people where encountered, almost half of them where related to logging (35), while in 2016 these were only 5. Number of people found in 2015 for other activities matches better with most recent data (25 palm-wine tappers, 7 people gathering snails, 3 farmers, 3 tourists with guides and 1 hunter). The decrease in the number of loggers found might be better justified by chance than by the decrease of logging pressure on ST forests.

Table 7 - Number of sections for which each activity was recorded and people encountered along the transects.

Distance	Snail Gathering	Logging	Hunting	Tapping	Barks	People
	Sections					found
100 - 1000	82	80	23	35	7	55
1100 - 2000	72	35	41	19	4	16
2100 - 3000	11	2	18	10	2	8
3100 - 4000	1	4	17	0	7	1
4100 - 5000	1	3	4	0	7	0
more than 5000	0	7	0	0	2	0
	167	**131**	**103**	**64**	**29**	**80**

Table 8 - Number of people encountered in each transect and activity done by them.

		Activity					
	People	Tapping	Logging	Snail	Tourism	Agriculture	Other
FormosoPequeno	23	21				1	1
ClaudinoFaro-DuasGrotas	12	7	5				
BomSucesso-Chamico	8				3	5	
Tras-os-Montes	8	6			2		
AguaJoao-Rosario	5			5			
Macambrara	5				1		4
DonaEugenia-AguaFerro	4	3		1			
Rebordelo	4				4		
SaoMiguel-Zagaia	4	4					
Quija-MonteRosa	3	3					
SaoJose	2					2	
RioAve	1	1					
SaoJoao	1					1	
	80	**45**	**5**	**6**	**10**	**9**	**5**

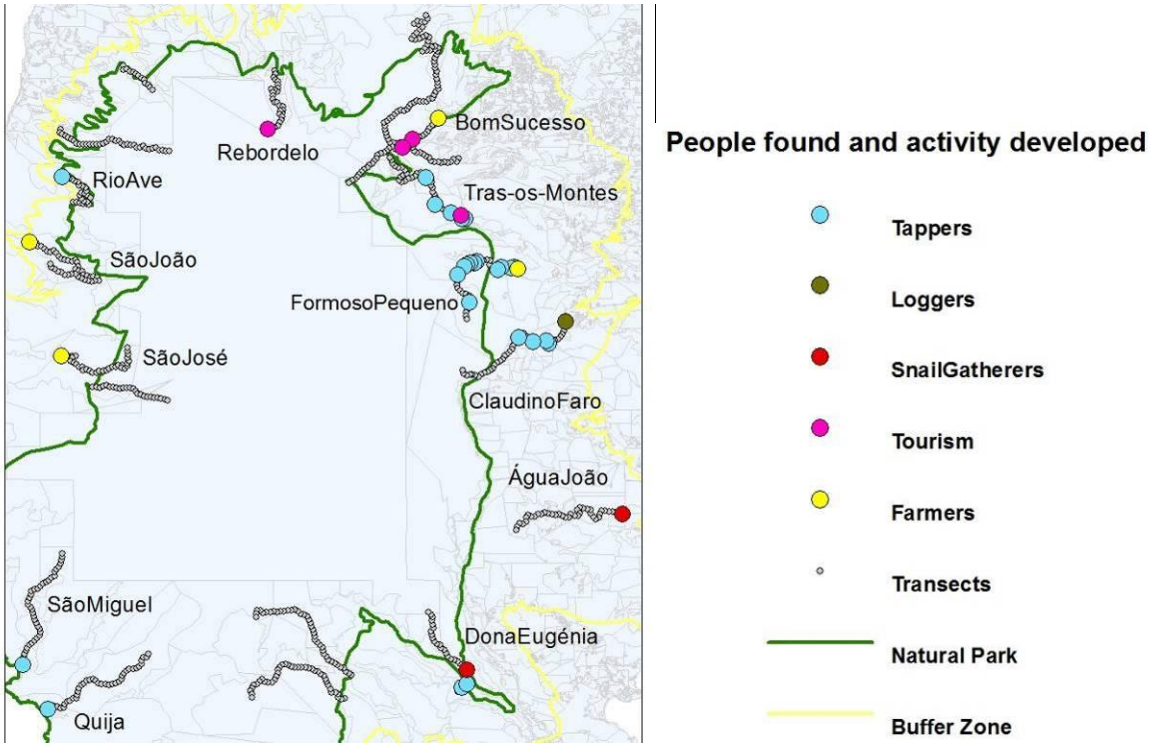


Figure 15 – People found along the transects and activity being developed by them.

Logging

Logging, which is an illegal activity was recorded all over the study area, more precisely in 14 transects (table 9 and fig. 16), and mostly in the northern and eastern part of the ONP and its buffer zone, once these areas are more accessible and closer to roads. Rio Ave and Claudino Faro-Duas Grotas have more sections with records of logging and higher number of trees cut, followed by SantaJenny, Mulundo, Rebordelo, SãoJoão and BomSucesso-Chamiço.

Investments that took place in the south of the island in the last years, with deforestation for oil palm production led to increase of roads and accessibility to new forest areas, but so far we have only found isolated records of logging in transects surveyed close to these areas.

This is a concerning activity, due to its significant and long-lasting impacts on forests. Some species are particularly valuable and actively searched for selective logging, but once preferred species become scarce and only found too far from roads and trails, less quality wood species start being cut. Moindro *Bridelia micrantha*, Gogo *Carapa gogo*, Mangue-d'obô *Uapaca guineensis*, Pau-branco *Tetrorchidium didymostemon*, Pau-vermelho *Staudtia pterocarpa*, Amoreira *Milicia excelsa*, Pau Formiga *Psydrax subcordata* and Viro were the most cut species (Table 10).

Most of the timber that comes from illegal logging is sold in the capital and its surroundings, which is concerning since communities that are losing good quality forests near their houses seem to be gaining little with this profitable activity. Most loggers are outsiders, who occasionally employ local people as helpers/carriers, resulting in little money kept in these communities compared to the total values

resulting from this illegal activity. Additionally carrying clapboards and other wooden materials for long distances is a dangerous and hard work. Illegal logging should deserve all attention from the local government as there is an urgent need of halting this threat and find alternatives to local timber for house building.

Table 9 - Prevalence of logging in each transect.

Illegal logging	Sections	nºtrees			
		Recent	Old	Unknown	Total
RioAve	20	8	25	2	35
ClaudinoFaro-DuasGrotas	19	15	28	12	55
SantaJenny	13	10	15	4	29
Mulundo	13	4	12	8	24
Rebordelo	13	19	3		22
SaoJoao	11	10	7		17
BomSucesso-Chamico	9	4		16	20
AguaJoao-Rosario	8	7	6		13
FormosoPequeno	7	15	3		18
Tras-os-Montes	6	2	4	1	7
Ermelinda-VilaVerde	6			3	3
SaoJose	3		3		3
Macambrara	2		1		1
DonaEugenia-AguaFerro	1			1	1
	131	**94**	**107**	**47**	**248**

Table 10 - Timber species most cleared.

Species	Transects	Trees
Moindro	8	38
Gogo	5	36
MangueObo	1	35
PauBranco	6	26
PauVermelho	4	20
Amoreira	7	18
PauFormiga	6	15
Viro	2	12
NesperaObo	1	8
CataGrande	2	5
Acacia	2	3
PauMaria	1	3
PauCadela	2	2
Cubango	2	2
SafuObo	1	2
Zamumo	1	1
QuebraMachado	1	1
Figo	1	1
Marapiao	1	1
GofeObo	1	1
Unrecorded	5	18
Total		**248**

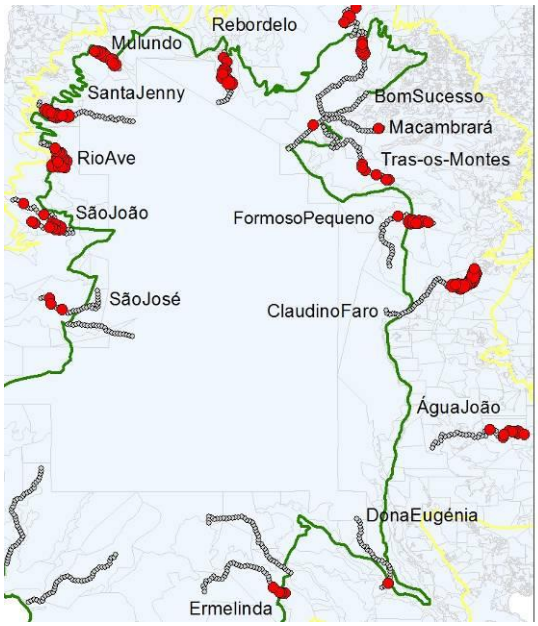


Figure 16 – Red dots representing records of logging for the transects monitored. The green line indicating Obô Natural Park, yellow line indicating buffer zone.

Palm wine

Palm wine is one of the most popular and cheapest drinks in ST, and as a consequence palm wine tapping can be a rather profitable activity. Signs of tapping were more prevalent in the eastern area, in Formoso Pequeno, Claudino Faro-Duas Grotas and Trás-os-Montes and in the western area of São Miguel-Zagaia (Table 11 and fig. 17). Those three transects from the eastern area also had the highest number of Oil Palms being used, specially Formoso Pequeno. This activity can vary along the year, namely according to season and intensity of rain, and this may help explaining the lowest number of signs of this activity in 2016 in areas like Ermelinda-Vila Verde and Dona Eugénia where it is common to find people extracting palm wine.

The palm-wine extraction is putting forests over pressure, as tappers are many and have to explore palms from farther areas, some of which of primary forest or old-growth secondary forest, as was recorded both in Formoso Pequeno and in Claudino Faro-Duas Grotas. This activity might seem less threatening than others, but involves a daily presence in the forest, ensuring an open access to the forest, and often coupled by other extractive activities, such as hunting. Furthermore, it has been noted that it implies an active management of the forest, with some plant species controlled to promote the growth of Oil Palm, promoting loss of forest habitat quality and the entrance and growth of non-native species typical from disturbed areas. This activity must be regulated in order to reduce pressure over important areas of forest and meetings should be organized with tappers for awareness raising and to discuss the best solution for integrating this activity in the forest in a more sustainable way.

Table 11 - Prevalence of palm wine extraction in each transect.

Tapping	Sections	Used Palms	Habitat		
			Obo	Capoeira	Tent
FormosoPequeno	24	109	34	75	3
ClaudinoFaro-DuasGrotas	10	22	22	0	2
SaoMiguel-Zagaia	10	10	0	10	0
Tras-os-Montes	9	24	0	24	0
Rebordelo	4	6	0	6	0
DonaEugenia-AguaFerro	2	4	0	4	1
Mulundo	2	3	0	3	0
Ermelinda-VilaVerde	1	1	0	1	1
SaoJose	1	3	0	3	0
RioAve	1	2	0	2	0
Total	**64**	**184**	**56**	**128**	**7**

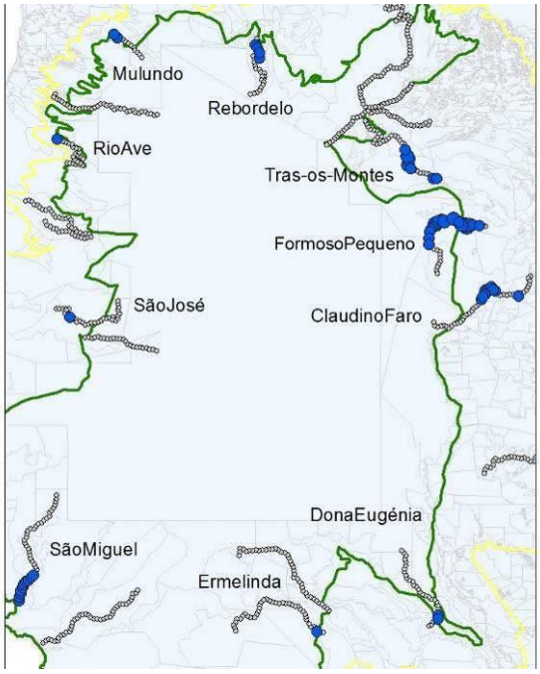


Figure 17 – Blue dots representing records of palm wine tapping for the transects monitored. The green line indicating Obô Natural Park, yellow line indicating buffer zone.

Giant Snail gathering

Giant Snail gathering was recorded throughout the island, in 15 transects but mostly in Caué district/southeast (Água João-Rosário, Dona Eugénia-Água Ferro and Ermelinda-Vila Verde) and Lembá district/northwest (São José, São João, Rio Ave and Dois Irmãos) (Table 12 and fig. 18). This is an important activity as this mollusc is still the main source of proteins in the most isolated and poor communities and an important source of income, as it is often sold to town. This activity alone is not of much concern, namely because it might help controlling the population of the introduced African Giant Land Snail *Archachatina marginata*, an invasive species that seems to be having a deleterious impact on the threatened endemic Gulf of Guinea Giant Land Snail *Archachatina bicarinata*. Thus this activity may

cause more positive than negative impacts, which are related to disturbance by human presence in the forest.

Hunting

Hunting activity is rather widespread and intensive, being recorded in 14 transects and in 103 sections (Table 12 and fig. 18), namely if we take into account that signs of hunting are much more difficult to find than those of logging or snail gathering, for example. Signs of hunting were mostly recorded in Claudino Faro-Duas Grotas and in Quija-Monte Rosa, however in the first trial in 2015 many signs were also found in São Miguel transect. This community, together with the close by Quija is located inside the ONP and in one of the less populated, most isolated and inaccessible areas of ST island. Hunters and palm wine tappers are known to come regularly to these locations, where they stay for some days. Product of their activities is then usually carried by boat to Santa Catarina where it is sold or taken to other communities, including the capital city.

Hunting can be a subsistence as well as a commercial activity, differentially targeting species such as the Mona Monkey, Pigs *Sus scrofa* and Pigeons (Carvalho *et al*. 2015). Unfortunately some quarry species are endangered and there is an urgent need to manage hunting to keep it as sustainable as possible and guarantee that disturbance inside the park and other important areas for conservation is reduced.

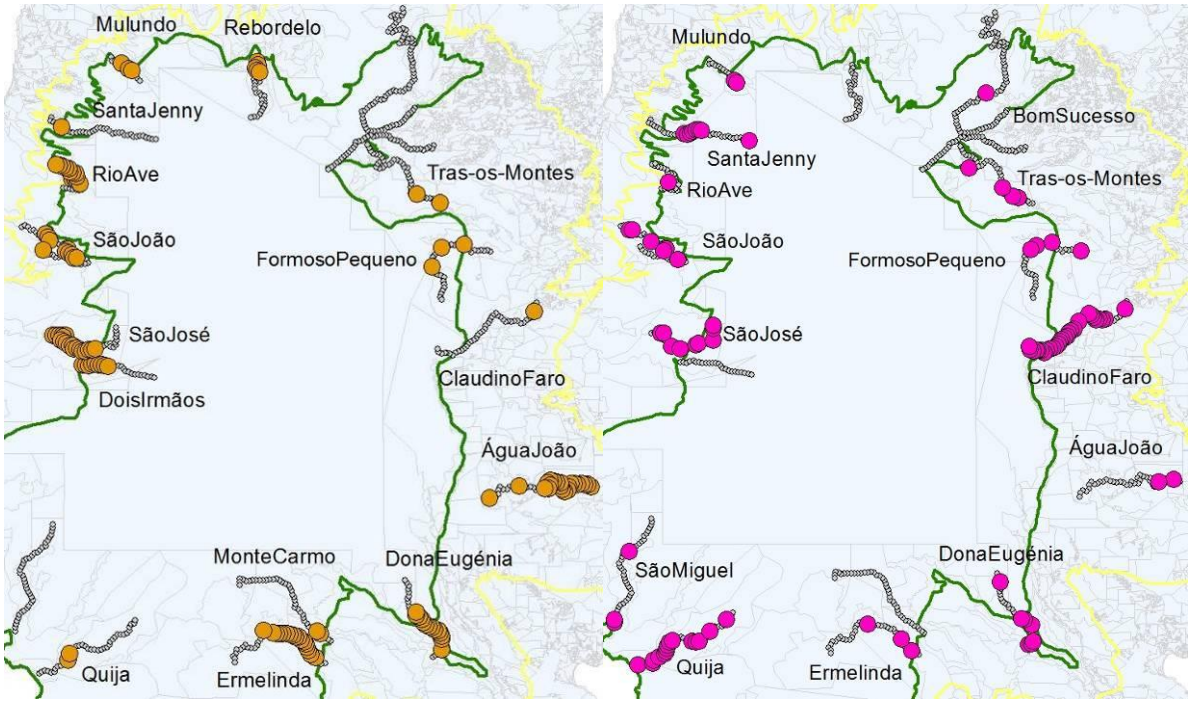


Figure 18 – Yellow dots representing records of Giant Snail gathering and pink dots representing records of hunting for the transects monitored. The green line indicating Obô Natural Park, yellow line indicating buffer zone.

Table 12 - Prevalence of Giant Snail gathering, hunting and bark collection for each transect

	Sections		
	SnailGathering	Hunting	Bark Collection
AguaJoao-Rosario	33	2	
BomSucesso-Chamico		1	11
ClaudinoFaro-DuasGrotas	2	33	1
DoisIrmaos	11		2
DonaEugenia-AguaFerro	19	8	
Ermelinda-VilaVerde	17	3	
FormosoPequeno	3	4	1
Macambrara			6
MonteCarmo-TiraFome	2		3
Mulundo	4	2	
Quija-MonteRosa	2	17	1
Rebordelo	6		
RioAve	15	1	
SantaJenny	2	9	1
SaoJoao	15	7	2
SaoJose	34	9	
SaoMiguel-Zagaia		3	
Tras-os-Montes	2	4	1
	167	**103**	**29**

Table 13 - Main tree species searched for their bark.

Barks	Sections
MateusJorge	13
PauPurga	3
Azeitona	3
MamaoObo	1
Marapiao	1
Mussinica	1
PauTres	1
PauImpe	1
Zamumo	1

Bark collection

Signs of bark collection were found in 10 transects but more prevalent in Mé Zochi district (Bom Sucesso-Chamiço and Macambrara) (Table 12 and fig. 19). Species most searched were Mateus Jorge *Syzygium guineense*, Pau Purga *Croton draconopsis* and Azeitona *Manilkara obovata* (Table 13). This activity is currently being practiced in a non regulated way and in some cases by people that don't have either the right knowledge or respect for tree conservation, performing this activity in the most profitable and less sustainable way. It is not a widespread activity in the island, but is causing negative impacts to some areas in particular, some of which inside the ONP. Thus it is important to regulate bark collection, accredit people that are allowed to do it and determine how much bark and how regularly can it be taken from trees.

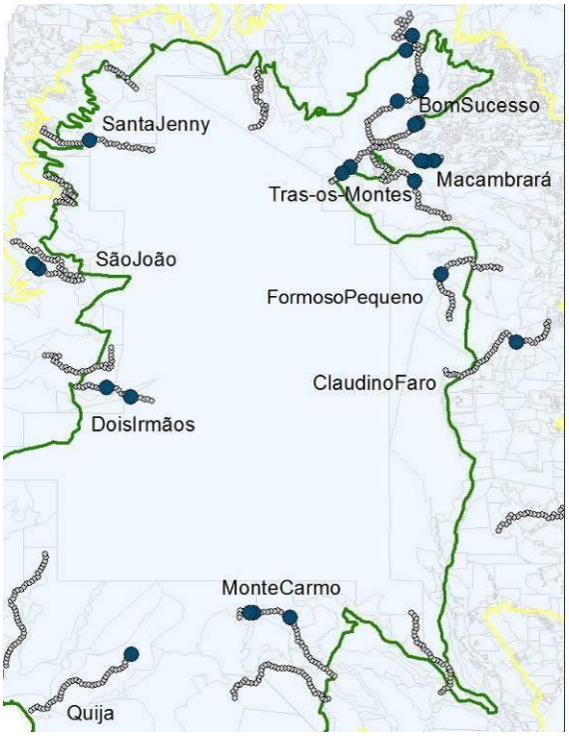


Figure 19 – Blue dots representing records of bark collection for the transects monitored. The green line indicating Obô Natural Park, yellow line indicating buffer zone.

Table 14 - Number of section with presence of livestock for each transect.

Livestock	Cow	Pig
	Sections	
ClaudinoFaro-DuasGrotas		1
DoisIrmaos		1
Ermelinda-VilaVerde	36	
Macambrara		2
MonteCarmo-TiraFome	28	1
SantaJenny		7
SaoJoao		2
SaoMiguel-Zagaia		26
Tras-os-Montes		4
	64	**44**

Livestock raising

Livestock raising is common in areas close to the communities but usually not widespread inside forest. However, when animals are freely raised in more remote areas, such as pigs in São Miguel (Table 14) this activity might have strong impact on forest ecosystems. Roaming pigs cause forest disturbance and diminish its regeneration, and often abandon their group and contribute to the feral population, living in

core areas of the park. In Monte Carmo and Ermelinda, a very important area for the CR Dwarf Olive Ibis, free roaming cows are entering far inside the forest and impacting understorey vegetation, the soils and forest regeneration. Livestock raising should be controlled and restricted to proper areas and its prohibition enforced inside the ONP.

Discussion

With this survey we were able to identify and quantify human activities being developed inside the most accessible areas of the ONP and Buffer Zone that surrounds it, record threatened birds that are using these areas. We have mapped areas that are under more pressure of resource extraction and disturbance and identified which activities present major threats.

We believe that urgent action is needed from ONP authority and Direction of Forests for regulating human presence inside the ONP, namely on areas most sensitive/important for conservation.

- Claudino Faro-Duas Grotas, Dois Irmãos, Dona Eugénia-Água Ferro, Monte Carmo-Tira Fome, Quija-Monte Rosa, São Miguel-Zagaia and Formoso Pequeno look particularly important for hosting CR species and other threatened birds;

- However some of this areas are exactly the same that are under highest human pressure, specially Claudino Faro-Duas Grotas, where we found many records of logging, hunting and palm wine extraction. Tapping is also threatening forests from Formoso Pequeno and São Miguel-Zagaia. Additionally in São Miguel pigs are being raised inside ONP forests, the same happening with cows in Monte Carmo whereas Quija-Monte Rosa transect is mainly used for hunting;

- Illegal logging is a major threat to the forest which is acting all over the study area. It has reached bigger proportions in the northern and eastern part of the ONP and its buffer zone. There is an urgent need of enforcement for halting this threat and finding alternatives to local timber for house building;

- Palm wine extraction is mostly degrading forests from the eastern area (Claudino Faro, Formoso Pequeno and Trás-os-Montes), but also in the western, isolated area of São Miguel. This activity must be regulated in order to reduce pressure over important areas of forest;

- There is also an urgent need to control hunting and bark collection to keep these activities as sustainable as possible and guarantee that disturbance inside the park is reduced. Giant Snail gathering should be monitored for better understanding of its positive and negative impacts, whereas livestock must be prevented of entering high conservation value areas of the ONP;

- Data from 2016 surveys gives the impression of a decrease in human presence in forest areas closest to Agripalma, once there were few records of logging, hunting and tapping in this three transects, but more data is needed for taking stronger conclusions.

By performing these monitoring transects we have gathered many important biological data which has not yet been fully analysed. However we can easily understand its potential and how important it can be if used as a longer term monitoring tool. Our intention is to keep repeating these transects regularly to

monitor forest habitat, evolution of human pressure and activities developed, invasive species and threatened biodiversity on the Buffer Zone and inside ONP, but this is depending of additional funding.

2.2. Invasive non-native species

There is much published information about the impact of alien species in islands worldwide, including many cases of endemic species extinction, but little has been done so far for STP regarding this issue. The island of São Tomé has been inhabited by humans since 1485 and it is extremely likely that Black Rats have been present on the island from this time (Jones and Tye 2006). The timing of the arrival of other mammalian predators is unclear, but it is thought that they have all been present for at least a century (Dutton 1994). Despite the presence of these predators, there have been no documented extinctions on ST, lending support to the argument that not all introduced mammalian predators can be classed as invasive and their presence does not necessarily lead to extinction.

However introduced species are a possible threat to the whole forest ecosystem of STP and to its endangered biodiversity in particular, as referred in the Action Plan for the Conservation of the 3 CR species of São Tomé. Native birds may be directly impacted by predation of introduced mammals such as monkeys, civets, cats, weasels and rats and the extent of this threat should be evaluated. It has been suggested that the Mona Monkey could be a contributing factor to the decline of the Dwarf Olive Ibis (Maia *et al.* 2014), but there is no evidence that invasive mammalian predators have contributed to the decline of the São Tomé Fiscal and Grosbeak.

During survey work, the presence of Mona Monkey was recorded and the distribution of the species was found to be very widely distributed (Fig. 20). We have also confirmed the presence of several introduced species in the vicinities of areas where the CR birds occur (https://vimeo.com/125478685, https://vimeo.com/125477691), but failed to confirm their negative impact on the birds. The impact of introduced species on ST native biodiversity remains little studied as a whole (Dutton 1994; Ndang'ang'a *et al.* 2014). Nevertheless, introduced species are well known for having strong negative impacts on native island species (Trevino *et al.* 2007), and the precautionary principle advises care until such fears are disproved. Many of these exotic species are likely to predate on birds (e.g. Mona Monkey, civet *Civettictis civetta*, Black Rat and Black Cobra *Naja melanoleuca*), others, like many of the introduced plants and feral pigs, might degrade the overall quality of the habitat. It is likely, but also unconfirmed that the Black Rat is a nest predator of ST forest birds. The quinine plant *Cinchona ledgeriana*, for instance, might pose a serious threat to the Fiscal, since it occupies the understorey (Diniz *et al.* 2002), which this bird needs to be open for hunting (Jones and Tye 2006, Lewis 2015).

Investigating the impact of introduced species on native birds and their habitat is therefore, and together with further studies on CR species ecology, identified as one of the most priority subjects for research under our conservation work in STP.

A first attempt was made in the field starting in October 2016, i.e. during the breeding season for most bird species, which aimed to: investigate the occupancy patterns of introduced mammals, with a focus on rodents; estimate the rodent population abundances in key habitats for native birds (forested

habitats); and evaluate mammal predation on native birds, to ultimately provide recommendations for conservation actions.

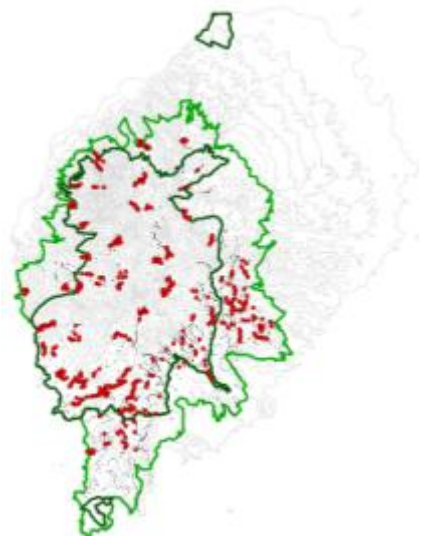


Figure 20 – Distribution of Mona Monkey, indicated by the red dots. The green lines indicating Obô Natural Park boundaries (darker green = core park, lighter colour = buffer zone). Background black lines are 50m altitudinal isohyets.

An MSc student from the University of Lisbon tried to conduct this study using both Sherman foldable live-traps (models XLF15 and XLK) and wax-blocks, for analysing stomach contents and estimating rodent densities respectively. Sampling was made along transects in areas where both Secondary Forest and Primary forest could be found nearby. In each habitat 26 foldable live-traps and 26 wax-blocks were set and visited each eight hours (6h, 14h, 22h) for three consecutive days. Live-trapping followed standard procedures (Gurnell & Flowerdew 2006) in accordance with animal welfare principles. For the wax blocks, every time one was bitten it was removed from the field for further analysis of teeth marks. At the same time, when camera traps were available, a trial was made to capture images of rodents visiting the traps.

Unfortunately this student didn't manage to adapt to São Tomé and to the tough conditions of field work and decided to quit the study, which led to constraints in the coordination of field work given the less availability of the team to carry out the study.

Therefore the study lasted for less weeks than it was foreseen which didn't allow to visit so many forest areas as we expected and to adapt the methodology according to the results that were being obtained.

We have managed to sample five areas: Macambrara - mountain forests, around 1300 m high; Mioba, Dona Eugénia and Água João - low altitude forests in the south, between 40 and 330 m high; and Santa Jenny: low altitude forests in the north 320 to 570 m high).

Only seven rats were caught inside the folding traps, which doesn't allow us to conclude about the inclusion of birds in the diet of rodents. Nevertheless, no signs of birds were found in any of the stomach contents analysed (Table 15).

However there were few rats caught with the folding traps, the wax blocks had much more success, as 34% of total were "visited". Globally, no significant difference seems to occur between habitats (39% for SF, 30% for PF), however in three areas results were distinct: Macambrara 36% for SF, 4% for PF; Santa Jenny 8% for SF, 27% for PF; Dona Eugénia 15% for SF, 0% for PF.

Forest areas at lower altitudes had similar results (Mioba 67%, Água João 60%), with exception of Dona Eugénia (8%) where results might have been distorted by Giant Snails, which have eaten many wax blocks.

Table 15 - Results of rodent study for each sampled location.

Area	Starting Date	Habitat	Traps/wax blocks	Rats caught	Wax blocks bitten
Macambrara	10/10/2016	Secondary Forest	25	1	9
Macambrara	10/10/2016	Primary Forest	26	0	1
Mioba	18/10/2016	Secondary Forest	26	0	18
Mioba	18/10/2016	Primary Forest	26	3	17
Dona Eugénia	22/10/2016	Secondary Forest	26	3	4
Dona Eugénia	22/10/2016	Primary Forest	26	0	0
Água João	31/10/2016	Secondary Forest	26	0	17
Água João	31/10/2016	Primary Forest	26	0	14
Santa Jenny	07/11/2016	Secondary Forest	26	0	2
Santa Jenny	07/11/2016	Primary Forest	26	0	7
			259	**7**	**89**

We have sampled less areas and spent less weeks conducting this study than intended, which prevented us of adapting the methodology to have more success in catching rats. Also do to the few number of sampled areas we can't be confident while concluding about rodent patterns between forest areas and habitats and whether they are impacting on native birds by predation or not. However we have collected interesting preliminary data that gives us some evidences about rodent presence in São Tomé forests:

- There seems to be a high relative abundance of rats in São Tomé forests overall, specially at lower altitudes where there shall be more food available, but evidences about differences between primary and secondary forest are not so clear.

- Only Black Rat has been caught inside the folding traps and filmed with camera traps (Fig. 21). This was also the only species caught in Monte Café where a first trial was conducted for five days. However we cannot exclude the presence of other alien rodent species in the forests of São Tomé, this study seems to indicate us that Black Rat is the main rodent that occupies this habitat.

- During this study one Brown Rat *Rattus norvegicus* has been caught in São Tomé (capital city). Apart from officially confirming the presence of this species in the island, what had not been done so far, it may also be an indicator of its habitat preferences.

Figure 21 – Images of Black Rat captured with camera traps while visiting folding traps.

2.3 Species Action Plan review

A workshop was held on the 23rd January 2015, with good participation from Government institutions, including staff from the Environment, Agriculture and Forest Departments, as well as District staff from key ONP areas. In addition, the local field guides attended and inputted to the discussions, giving a short presentation on their involvement in the project. The progress towards the International Species Action Plans (SAPs), as outlined under objectives 1 and 2, was presented and reviewed, as well as the significant progress made in collecting more information on the CR species distribution and ecology. The progress made with initial awareness raising work and fact finding with communities and hunters was also shown.

We promoted discussions on the challenges and obstacles faced by the different stakeholders to implementing the SAPs. Key points raised, included the lack of Park staff and budget to implement the activities. Limited awareness of the conservation status of the species and on the importance of the park was also highlighted by several different participants. Increasing the regularity of information provided to the Government staff on the outcomes and progress of the project and SAPs was also mentioned.

Species Action Plan workshop

There was excellent participation from the workshop attendees on the discussions and identification of these challenges and actions are extremely useful in providing a plan for future development of the work. The workshop was covered on national TV, on the news that evening, including interviews from the project staff and from the Head of the Park.

2.4 Park Management Plan review

The park management plan has been reviewed. Project partners inputted to discussions with the consultant who led the review and whom requested a lot of input from the project partners. It was clear the knowledge of the partnership was appreciated, particularly recognised was the value and relevance of the information outlined in this report for inclusion within future protected area planning.

Key areas of concern regarding previous management plan

- Lack of implementation and lack of funding
- Lack of focus
- Too ambitious
- Mainly focussed on communities, needing more on species and habitats conservation and protection
- More actions were proposed in buffer area than in core park
- A lot of mapping was not based on field data so do not always translate to what is actually on the ground, for instance in terms of park zonation
- Needs more specifics and work plan for activities, that are more clearly presented
- Needs identified group of stakeholders to lead on implementing and monitoring progress

Priorities for inclusion in the management plan were identified as:

- Review of the current zonation, in light of new information on threatened species and based on important forest for full protection and review activities allowed in different areas
- Inclusion of the priority activities in the Species Action Plans
- Development and improvement of the surveillance and enforcement plan

- Development and improvement of the engagement of communities in Park Management and opportunities for Community Forest Management assessed– existing livelihood work has not been linked to conservation and it is critical that support provided to the communities in relation to park activities has some benefit for the park and conservation and building awareness. This could be:
    - in response to getting support for livelihood development, communities formalise an agreement on where not to extract forest resources and reducing pressure at sensitive sites, or,
    - where livelihoods are developed that explicitly provide conservation wins such as improving community capacity on agriculture, such as pig farming and keeping pigs in enclosures, this would reduce the occurrence of free pigs entering the forest and becoming feral
- Establishment of Park entrance fees and regulation
- Identification of a Committee to oversee implementation, and for this to include Rede – Bio, a network of local environment NGOs, and BirdLife
- Provision of a lot more detail on prioritised activities in terms of budget/timeline/responsibilities
- More information on strategic funders, fundraising ideas for enabling Plan to be implemented
- Consideration of increasing protection for areas currently falling outside Management Plan

2.5 IUCN Red List conservation status review

The revised potential distributions and population estimates presented could warrant a change in the status of the 3 CR birds in the IUCN Red List (IUCN 2013). The Ibis is classified as CR due to having a declining population, smaller than 250 mature individuals and confined to a single location (criterion C2a(ii) – IUCN 2001, IUCN 2013). According to our findings, this criterion no longer applies. However, the species is restricted to less than 100 km^2 during the breeding season and to a single location, with an inferred continuing decline in the area, extent and quality of its habitat, and in the number of mature individuals, for which we suggest that it should retain its classification, under different criteria (B1a,b(iii,v)) even if its population is larger than previously assumed.

The Fiscal and the Grosbeak are both classified as Critically Endangered due to having extremely small population sizes, with less than 50 mature individuals (criterion D – IUCN 2001, IUCN 2013). Our data, together with observations of other authors (Solé *et al.* 2012, Ndang'ang'a *et al.* 2014, Lewis 2015) suggests that the rationale for these statuses should be reviewed, as the populations are larger than previously thought. If this proves to be the case, the category 'Endangered' will perhaps be more appropriate, due to their extents of occurrence being smaller than 5,000 km^2 and restricted to a single location, with an inferred continuing decline in the number of mature individuals and in the area, extent and quality of their habitats (criterion B1a,b(iii,v)). However we are uncertain if the precautionary principle should be applied and this two species retained at CR.

Objective 3: Targeted advocacy communications and awareness raising, secures greater commitment from key stakeholders to reduce the extinction risk of all three species

3.1 Hunting interviews and awareness raising

Besides being threatened by habitat loss and degradation, several endemic birds, including the Dwarf Olive Ibis, suffer direct impacts from hunting. Based on information gathered in previous studies on hunting practices in ST and from casual conversations with users of forests resources, it was clear that hunting was an active threat to this bird. However, there were no data on how many people hunt the Ibis and how many birds are killed, and it was impossible to determine hunting pressure and resulting impacts on its population. This CR bird has a very restricted distribution and declining population, being urgent to gather the information needed to evaluate the extent of hunting as the first necessary step for undertaking appropriate measures for halting this threat.

Methods

A previous project on pigeon hunting, created a list of ST hunters (Carvalho et al 2015), which we extended with the help of local field assistants. The pigeon hunting project identified three groups of hunters, distinguishable according to their key quarry species. One large group targets pigeons, and don't generally enter too far into the forest, another targets mostly monkeys and again doesn't enter too far into the forest. The final group are more focussed on hunting pigs, and they enter further into the forest, walking large distances to get to remote locations that take them through the Ibis distribution area (Carvalho et al 2015). The pigs are scarce and not always easy to find, leading these hunters to hunt the Ibis opportunistically, to avoid returning home empty-handed.

The awareness raising and data collection targeted the latter group. Objectives were to: 1) evaluate hunter knowledge, behaviour and attitude towards the Ibis; 2) characterize the hunter's background, preferences and practices; 3) identify an approach to reduce hunting pressure over the Ibis

We interviewed the hunters following a semi-structured questionnaire, based on the experience of previous projects with similar goals, particularly that on pigeon hunting. The interviews have been informal, as experience of social scientists working in ST, has shown this is the most successful method of getting the required responses. We identified the hunters following a snowball approach, starting from the pre-existing list of hunters. To facilitate communication, the interviewer was accompanied by a local guide familiar to most hunters in the island.

Results

We interviewed 93 hunters, from 13th November 2014 to 6th March 2015. Interviewees were from 31 localities spread across São Tomé (Fig. 22). Claudino Faro was the community with the highest number of interviewed hunters (14%). On average, the hunters were 37 years old, had started hunting when they were 18, and had been hunting for 20 years. Only one of the interviewees was a woman.

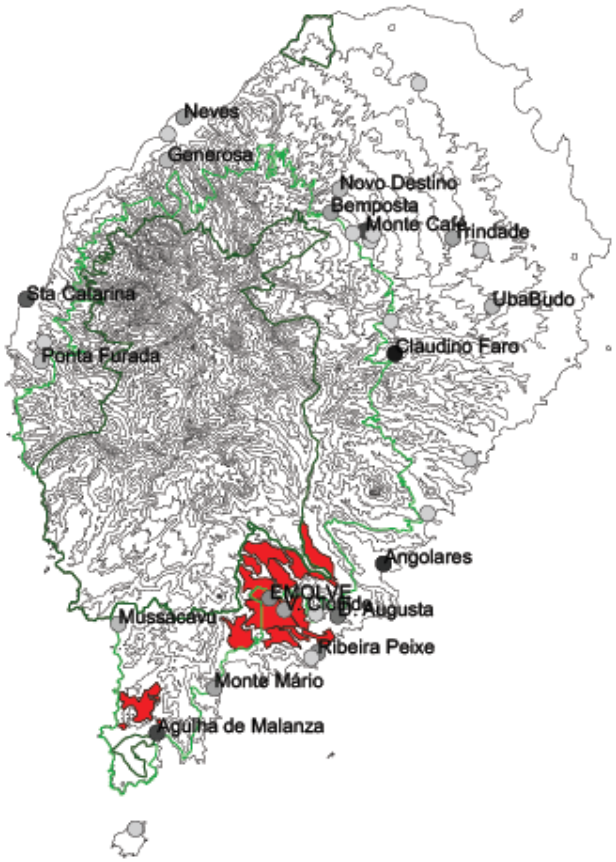


Figure 22 – Home locations of hunters across São Tomé. The grayscale dots represent the number of hunters from each locality, with darker colours indicating higher numbers of hunters. The sites labeled are home locations of more than one hunter. The green lines indicating Obo Natural Park boundaries (darker green = core park, lighter colour = buffer zone). Background black lines are 50m altitudinal isohyets.

Hunters' knowledge of Ibis ecology

Regarding the habitat used by the Ibis, 66.66% (n=75) of the hunters stated that it is mostly found in primary forests, locally known as Obô, with 13 hunters specifying that it was found inside the Obô Natural Park. In terms of the Ibis distribution, São Miguel was the most mentioned location (24.29% of hunters; Fig. 2a; n=79), followed by Santelmo (15.07%), Mato Perdido (15.07%), Monte Carmo (15.07%), Duas Grotas (13.70%) and Vila Machado (12.34%). This roughly coincides with the known areas for the occurrence of the Ibis (Fig. 23).

Ibis are most regularly observed in groups by the hunters surveyed, mostly pairs. Four of the hunters surveyed implied that the Ibis has seasonal movements.

In terms of breeding ecology, the hunters response to nesting preferences was varied, indicating that the Ibis nests in trees, but varying in height, with 23.63% of the hunters saying Ibis nest high (>10m), and 25.45% of the hunters saying Ibis nest low in trees (<10m) (n=55). Several hunters referred to the nest being made from small sticks and two hunters said that the Ibis builds the nest on a bifurcating branch of the tree. Several hunters noted nest failure due to predation by monkeys (n=4) and snakes (n=1), and

nests had been actively destroyed by four of the hunters. Of those who knew, the majority (48.48%; n=33) said Ibis have two eggs/chicks.

The information obtained from the surveys indicates that the hunters' perceptions of Ibis ecology are very similar to that currently believed by scientists. Interestingly, seasonal movements of Ibis were mentioned by several hunters, which had not been recorded before for this species.

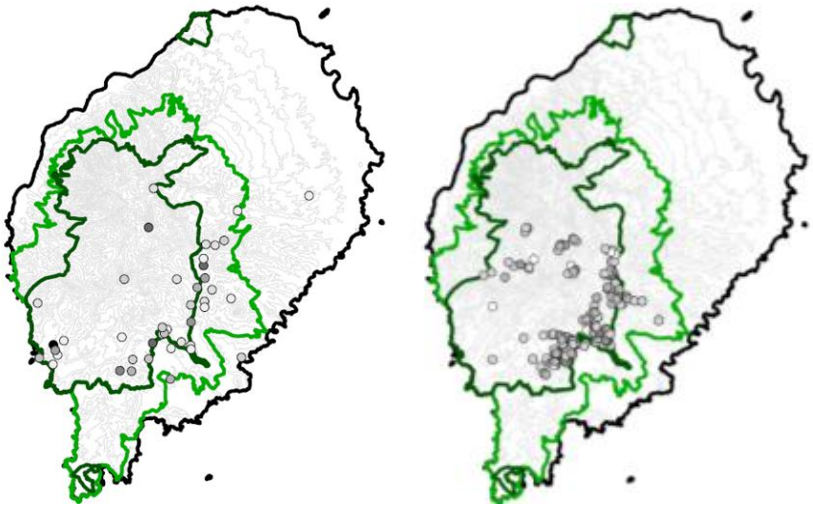


Figure 23– Distribution of the Ibis (a) as perceived by the hunters and (b) as recorded in BirdLife's GPS locations' database. The dots with darker colours indicate (a) more mentions of a location or (b) larger group sizes. 100 m altitudinal isolines on the background. The dark green line represents the boundaries of the Obô Natural Park, and the light green that of the corresponding buffer zone.

Of the hunters who provided information on noticeable changes to the Ibis distribution (36.56%), logging and oil palm plantations were considered the main reason for those changes (41.18%; n=34). Eleven locations were considered to have been extirpated of Ibis (Fig. 24), with seven of the hunters directly mentioning that in some locations this happened as a direct impact of deforestation for Agripalma's oil palm plantations. Another two mentioned logging as the cause but didn't refer to any particular location. Overhunting and disturbance were also referred, by two hunters, as being responsible for changes in Ibis distribution. Two hunters also mentioned new locations (Rosário and Monte Fuji) where they can now find the Ibis where it was not present previously.

Most of the locations highlighted by the hunters as previously supporting Ibis either overlap directly with the areas cleared for palm oil by Agripalma or are situated close to these. Additionally to the direct impact of habitat loss, there's an increase in disturbance and other associated impacts (climatic, invasive species, etc.) that may have also caused the decrease in Ibis in these areas. In other areas referred by hunters as previously supporting Ibis overhunting and human disturbance may have contributed to its decrease.

Areas previously supporting Ibis	No. Records
Assentada Grande	4
Burnay	1
Dona Eugénia	4
Monte Carmo	2
Mufucu	1
Santelmo	1
Guayaquil	1
Maria Fernandes	1
Ermelinda	1
Sarracinda	1

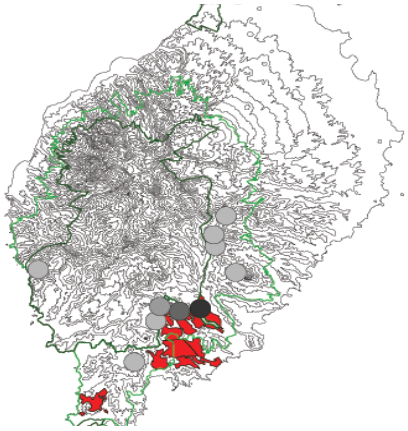


Figure 24: Location of areas mentioned by the hunters as having been extirpated of Ibis. The dots with darker colours indicate more mentions of a location. The red polygons indicate areas that have been planted for oil palm by Agripalma. 100 m altitudinal isolines on the background. The dark green line represents the boundaries of the Obô Natural Park, and the light green that of the corresponding buffer zone.

Hunters' perceptions of Ibis population and status

The majority of the hunters surveyed could identify Ibis from photographs and descriptions (88.17%). Some (43.75%) of hunters suggested that the Ibis population is increasing, compared to 31.25% who suggested it was decreasing (n=63). However, it seems that the perception of the population status of this species changes with the length of time hunting. Those who have been hunting for more than 20 years were, when they expressed an opinion, more likely to say the population is decreasing or stable when compared to those who have been hunting for fewer than 20 years.

Many of the hunters surveyed did not think the Ibis is a threatened species (63.08%; n=63), however this may be partially due to them misunderstanding the meaning of this word when used in a scientific context. The majority of hunters considered the Ibis to be important; given the ability to choose just one option, 21 hunters (38.89%) think it is important for São Tomé as a unique beautiful bird, whilst 18 hunters considering the Ibis as important for food (33.34%) (n=54). Nine hunters noted that it must be important as foreigners were coming to look for it and could be important for ecotourism (16.67%).

Hunting pressure on Ibis

The most mentioned hunting locations include: Agrião (22.58% of hunters), São Miguel (22.6%), Guayaquil (17.2%), Caué (17.2%), Santelmo (17.2%) and Vila Machado (15.05%) (Fig. 25; n=93). The majority of hunters would travel back every night after hunting and would only occasionally sleep over in the forest.

When hunters were asked which species would they usually target, most affirmed pig (93.18%) and monkey (69.32%) but also many admitted to hunt civet (32.95%), pigeons (26.14%), fruit-bats (26.14%) and Ibis (7.95%) (Fig. 26; n=88). Pigs and monkeys are both introduced and likely to be having negative impacts on forest ecosystems. This is a positive outcome, as perhaps these species can be promoted as prey species.

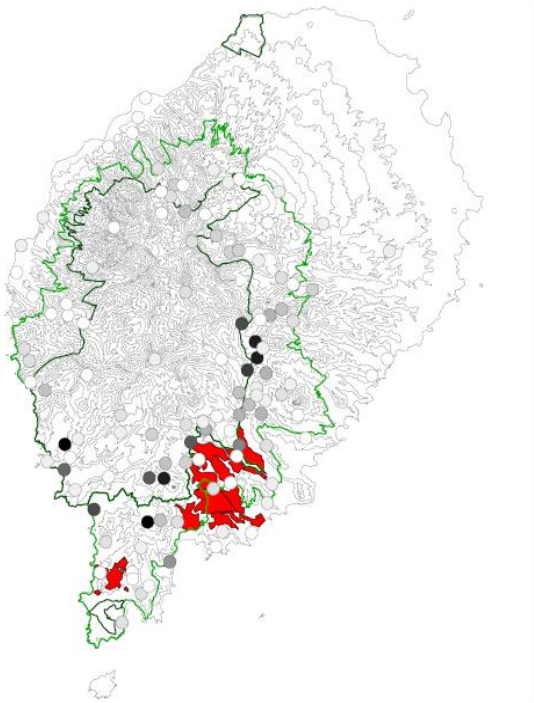


Figure 25: Distribution of hunting locations in São Tomé. The dots with darker colours indicate more mentions of a hunting location. 100 m altitudinal isolines on the background. The dark green line represents the boundaries of the Obô Natural Park, and the light green that of the corresponding buffer zone.

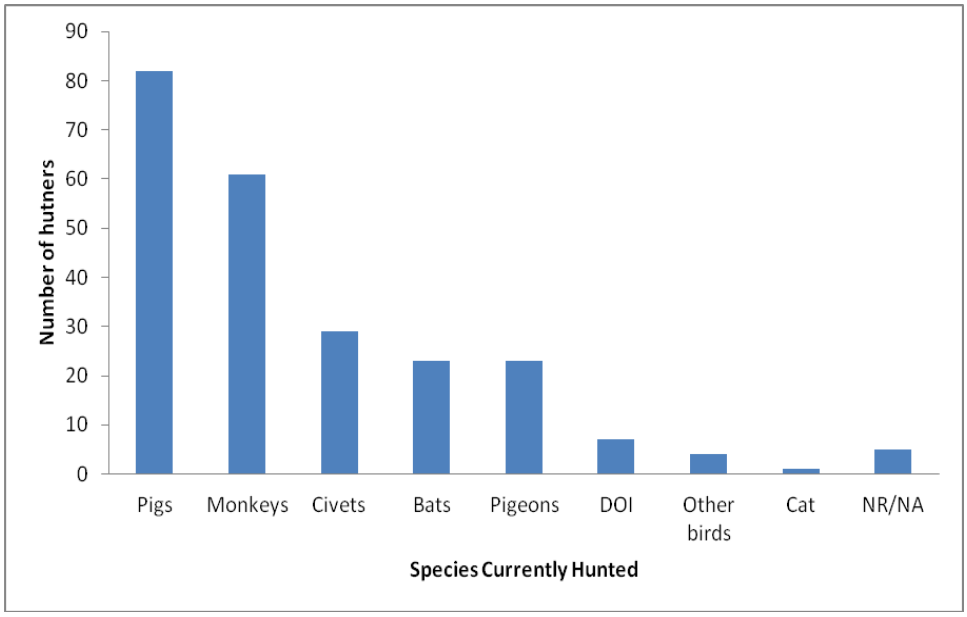


Figure 26: The species actively hunted in São Tomé by cohort of hunters surveyed (n=88). DOI indicates dwarf olive ibis.

When hunters were directly asked if they had ever killed Ibis, 46.91% said they had never killed it (n=81). Of the 40.86% who have killed this species, 19 hunters affirmed to have only killed it occasionally, with less than 10 individual overall. However, 28.40% of the hunters surveyed said they kill Ibis on a regular basis; of which 11 hunters kill between 1 and 5 per month, normally when no other food is available; and

12 hunters regularly targeting Ibis, with more than five killed each month (Fig. 27). One individual hunter, who had affirmed to have killed Ibis, did not quantify how many. Only two of these 81 hunters mentioned the Ibis being sold for meat, for between 2 euros a bird and 4 euros per kilogram. Furthermore, four hunters confirmed they had destroyed an Ibis nest, and over the last year two hunters are known to have collected live young birds.

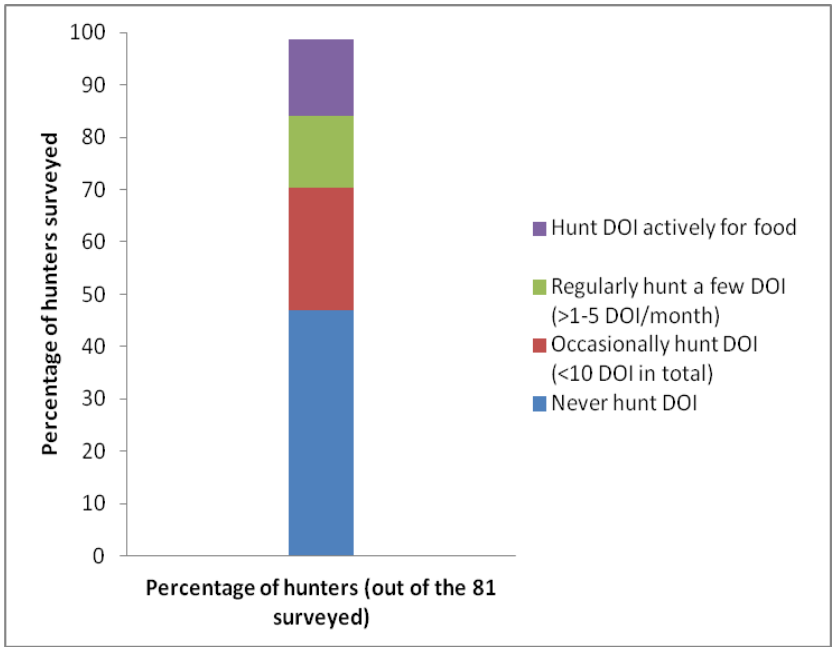


Figure 27: The percentage of hunters surveyed that have never hunted Ibis, occasionally hunt it and those who regularly/actively do it (n=81).

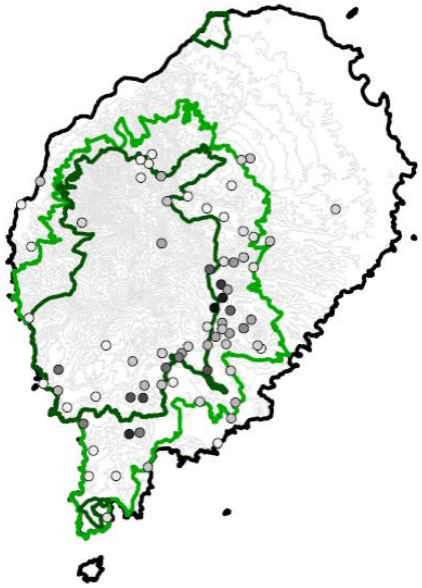


Figure 28: Distribution of Ibis hunting pressure in São Tome, as indicated by the cohort of hunters surveyed (n=76). The dots with darker colours indicate higher number of hunters using the area. 100m altitudinal isolines on the background. The dark green line represents the boundaries of the Obô Natural Park, and the light green that of the corresponding buffer zone.

The locations most frequented by the hunters are situated around the south-eastern limit of the ONP, namely the area around Agripalma's oil palm plantations (see Fig. 28), with many locations being referred (e.g. Dona Eugénia, Umbugu River, Monte Carmo, Ermelinda, Pico Cão Grande, Agrião).

Options to address hunting

When asked how the hunters could reduce or stop the hunting of the Ibis, three main methods were suggested by the hunters: (1) pay compensation to the hunters; (2) education; and (3) legal action - protect the Ibis legally; enforce surveillance and confiscate guns without licenses (Fig. 29). Of the 70 hunters who gave a response, 80% suggested some form of education would be an effective way to stop the hunting of Ibis, through talks and community events.

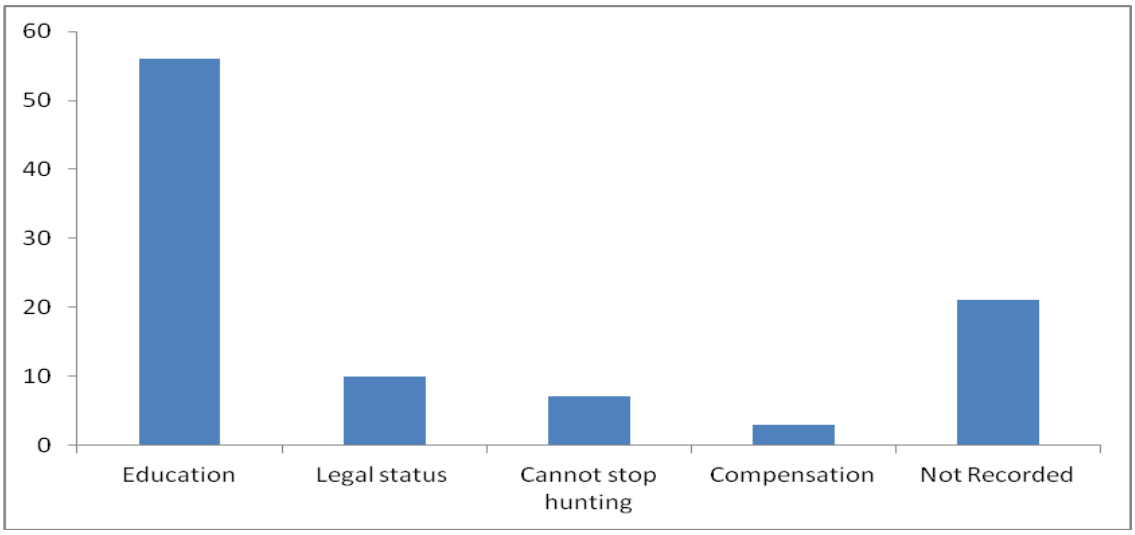


Figure 29: The suggested methods and actions required by the hunters to enable a reduction in the number of Ibis killed (n=70).

The key issue to address is that, many hunters recognize the importance of the Ibis which we see as a result of raising awareness actions that have been developed in the past, namely focusing on threatened endemic biodiversity (mostly about birds), which took place even in small and isolated communities.
However, despite considering it somehow important most hunters aren't aware of the fact that this species is threatened of extinction. Therefore we believe it is very important to continue raising awareness on these issues. If hunters understand the Ibis might disappear as a consequence of their actions, maybe it will be easier to convince them to stop killing it.
Future communication needs to focus on the message that the species is indeed important, and it is also threatened and could go extinct if we do not work together to address the current threats.
Educational activities were the most commonly raised idea by respondents and several hunters also made references to previous effective educational work. Educational activities are also the most feasible option to be achieved within short timeframe. Key messages for awareness-raising would be:

- Discourage Ibis hunting on the basis that it is unique to the country, endangered and faced with extinction;
- Raising awareness that the species is protected from hunting by the law;
- Advocating hunting non-native species; and
- Seeking to work in a collaborative way with hunters.

We suggest three approaches to awareness-raising:

- Building on existing interview / discussion based approach and rolling this out with the group of 93 and possibly expanding to further hunters;
- Undertaking radio interviews with hunters on local stations and on the discussion hour programme on national radio station; and
- Design promotional t-shirts / caps with positive message about protecting the Obo Natural Park and unique wildlife.

The identification of a few (1-3) obvious champions from the bigger group who could be first be engaged with to become 'conservation champions' (e.g. through consistent field work engagement) would be a sensible approach, and would enable some form of local ownership. In the short-term, the type of engagement needs to be targeted for hunting groups, generally focused at men in their late 30s who have been hunting for a significant period of time. There is also a need for a form of community engagement that can involve a wide range of ages (from 18 – 70 years old), structured in a way that will be applicable to those who have been hunting for up to 20 years. In the long-term, a school education based programme will help to ensure the next generations are aware of the importance of STP's endemic wildlife, including the Ibis.

This community engagement should be targeted at the main communities/hunting groups involved with Ibis hunting; notably those listed in Table 16.

(b) Increased surveillance

Another activity put forward to address hunting is to work with existing networks of identified and interested hunters in some of the key forest edge communities, who could be supported to become species champions. This would involve them recording any instances of the bird being killed and reporting these figures to the Forest Department and BirdLife Partnership representative. Their main role would be to promote protection of the Ibis, raise awareness on the legal protection and importance of the species. This effort could be targeted at park entrances and in communities identified above.

The individuals would likely need training in approach. In addition, consideration would need to be given to how these individuals would be recognised for their work. This would need to be discussed in-country.

Additionally, Forest Department staff should be given training in surveillance and awareness-raising for targeting hunters that kill the Ibis. This can only be achieved if a project for Natural Park management is financed.

(c) Legislative

In early 2016, the São Tomé Hunting Law was enacted (FAOLEX, 2016). This recent current legislation states that hunting licenses are required; it is illegal to hunt endangered species (including the Ibis); and forbids hunting in protected areas, i.e. São Tomé Obô Natural Park (FAOLEX, 2016). Penalties for offences in relation to this legislation are also detailed (FAOLEX, 2016). There is a provision within the law for control of invasive species, within the park. This could provide an interesting approach to promote to hunters, whereby BirdLife team support hunters to complete these applications and enable them to take this forward on the condition that they commit to not taking any endemic species.

The BirdLife team could also work on enabling the hunting group to make recommendations about revision of the hunting law to make it more fit for purpose.

(d) Incentives

Compensation payments were identified by a small number of the hunters surveyed, as a method for enabling the reduction in hunting of Ibis. However, a payments system would be extremely complex to manage and open to financial issues and mismanagement. A potentially more suitable approach utilized in other countries and trialled successful through existing projects in-country to support poverty alleviation and sustainable development is providing in-kind support to enable alternative livelihood development. Potential livelihood options could be sought from the hunters when engaging them during the awareness sessions. This could result in a more reliable and profitable income stream, however most likely would be dependent on international funding aid.

When investigating the drivers of pig hunting group however, the rationale is often due to the activity being enjoyable and for sport and therefore not about subsistence. Therefore, another incentivised approach has been put forward instead. Due to the recent changes within the law, the value in hunting groups becoming more organised and self regulating has increased. Currently, hunting is not regulated, monitored or organised in any way, which makes it difficult for interested stakeholders to work with hunters. Considering the changes to law, having a more organised hunting group structure, which takes more oversight of hunting policy implementation, regulation, licensing would enable hunters to have more control over what happens next with the policy. The project could help facilitate this happening through supporting the first series of workshops to take place. In addition, project staff can help provide a bridge with the Forest Department and potential engagement in improvement in the law.

Further developments

In March 2016 project team organised meetings with Ibis hunters in São Tomé Island as a follow-up of previous work developed with them and reported above.

From first interviews we realised that continuing engaging with hunters would be crucial to understand how many Ibis are actually being killed and would be one of the best approaches to sensitise hunters to the fact this is a threatened species and therefore to convince them not to kill this species anymore. Additionally, since March 2015 some of the hunters interviewed have come to us asking for the results of this study and saying they were still waiting for us to meet with them again. Therefore, we tried to organise meetings with most of pig/Ibis hunters from our list, giving preference to the ones already

interviewed by us and to those that admitted to kill this bird. We also gave preference to visiting communities where there are more hunters targeting the Ibis (Table 16).

We have visited 11 communities and managed to meet with 66 hunters. From these 44 had participated in the first interviews, of which 23 admitted to have already killed Ibis (Table 14). Communities where we were able to meet with more hunters were Claudino Faro (13), Angolares (9), Agulha de Malanza, Ribeira Peixe and Trindade/Milagrosa (all with 8).

We held meetings either with one hunter alone or with a group of hunters, accordingly to what was easiest to organise in each case.

Table 16 - The community locations which experience Ibis hunting, and the number of hunters for each community location that have hunted this species. Whether this is occasional or regular hunting is also indicated.

Community	**Number of hunters having killed DOI**	**DOI regularly hunted?**	**Date (2016)**
Angolares	8	Yes	17th March
Claudino Faro	5	Yes	21st March
Dona Augusta	4	Yes	16th March
Ribeira peixe	4	Yes	16th March
Vila Clotilde	3	No - occasional	16th March
Agulha de Malanza	3	Yes	16th March
Santa Catarina	3	Yes	18th March
Emolve	2	No - occasional	16th March
Monte Café	2	Yes	NA
Santo Antonio de Mussacavu	1	No - occasional	18th March
Angra Toldo	1	Yes	17th March
Generosa	1	No - occasional	NA
Trindade (Obo Lombo)	1	No - occasional	22nd March
Conde	1	No - occasional	NA
Neves (prédio)	1	No - occasional	NA
Novo Destino	1	Yes	NA

Meetings started by briefing information gathered and what were the most important results obtained from the interviews, while acknowledging hunters for having given us this precious contribution.

Emphasis was given to:

- Number of hunters interviewed and which communities have had more hunters interviewed;
- Ecology of the Ibis, regarding what hunters have told us and lauding them for knowing a lot about this species;
- Areas where they say the Ibis can be found and how close this is to the distribution area known by scientists;
- Telling them that half of the hunters interviewed don't know the Ibis is endangered of extinction and that they have independently referred 11 areas where they don't find the species anymore. We told them in some cases this was due to deforestation but that in other cases the probable cause was human disturbance (overhunting and palm-wine exploitation) as those places coincide with areas where more hunters admit to go hunting;
- High number of hunters that admitted to have already killed Ibis and that too many hunters admit they regularly kill this bird. We told them they aren't aware of the fact that there are too many hunters chasing this species in different areas of the island. Each of them doesn't hunt a lot of birds but altogether this is more than the species can stand. Therefore the Ibis will become extinct if they don't stop hunting it;
- Areas where there is more hunting pressure on the Ibis according to the hunters and how this coincides with important breeding areas;
- The ways they have told us we could reduce Ibis hunting, namely by awareness raising and education.

After this briefing, we would raise awareness by telling:

- How precious and important the species is as an unique bird and that many people are coming to São Tomé just to see it. It is worth much more alive than when they kill it for food;
- Those people that are coming to São Tomé just to see the Ibis, they spend their money in our country from the moment they arrive at the airport. They are not paying only for a guide to take them to the forest., they are spending money in restaurants, in transports, hotels, etc. The guide that is hired will then spend his money in his community and someone else will be gaining. After all we all are gaining with tourists that are coming to see birds;
- That nature is very important and the forest must be protected, as the Obô regulates climate and gives us many resources as food, water, oxygen, timber for house construction, medicinal plants, etc. This is their main richness;
- Those things are invaluable and priceless; no one can live without them. Animals are part of the ecosystem, for example birds are crucial to seed dispersion, bees are responsible for pollination, etc.

Those arguments would raise discussions but most of the times hunters ended up agreeing with us. Some would say they wouldn't have killed Ibis if they knew it was so important and unique. From now on they suggested that they would not kill it anymore and would tell other hunters to stop chasing it.

It was unclear if the team had fully taken the message on board, or if they were just agreeing with us at that moment but would then continue killing the Ibis. But what seems to be true is they like to have our attention. They are also interested in the fact that there are foreigners coming to São Tomé to work with a bird and to know they play an important role in that. They feel more important and respected because of that.

Therefore, even though this is a difficult group to work with and even if most of them will not stop killing the Ibis so easily, we still think our best option is to continue engaging carefully with them.

Figure 30: Photos of raising awareness meetings held in Agulha de Malanza and Dona Augusta.

Next steps

After this second session of meetings we have been developing material for being distributed to hunters during next events we organise with them. We have chosen caps as this is something rather visible and useful for them and we think they will appreciate it. On the cap we have stamped the slogan "Obo sá gi non" which literally means "The Obo is ours" (Fig. 31) and produced 200 units. With this slogan we intend to raise their sense of ownership regarding the ONP as well as their role and responsibility to protect it and use it in a sustainable way.

We are now planning to organise another session of meetings where the caps will be distributed. The objective of this meetings will be to:

- give information about the hunting law, and explain what would change in their activity if this was implemented;

- discuss potential interest of hunters of being organised in hunters associations;

- discuss hunting sustainability, the problem of Ibis hunting and the importance of implementing and respecting hunting seasons, namely by establishing stoppage periods during the breeding season.

We are also planning to do radio interviews with hunters and possibly participating in a TV program to raise the subject of hunting, its negative and positive impacts, the implementation of the hunting law, hunters' knowledge of forest and alternatives to hunting activity.

Figure 31– Caps designed by project team for being distributed to hunters during next raising awareness sessions.

3.2 Hydropower advocacy

Energy demand outstrips supply in ST, with energy shortages a regular occurrence. Hydropower seems to be the key sector for growth to address this. An agreement between Brazilian company TECHNIC and STP's Ministry of Infrastructure and Environment was signed on Nov 14th 2013, for 46 million euros, to build and operate a hydroelectric dam with 12 MW of generating capacity on the Tô Grande river for 25 years, starting from 2016 when the dam was guaranteed to be ready for operation. This was an important event in STP and signature took place in the presence of the Prime Minister. The project is proposed to be located inside the ONP, and has the potential to destroy biologically sensitive areas, including clearance of protected forest and loss of species. Of particular concern would be the impact on the CR Dwarf Olive Ibis, whose population overlaps with the proposed site, and could be driven to extinction by the development.

Project partners undertook a lot of research to identify the funding sources for the project and of the company TECNHIC. No information on funding could be found, however funding was confirmed not to be coming from development banks or international aid. The company has an extremely restricted online presence. We contacted office telephone, and the line did not connect, and visited offices in Lisbon and found they did not exist. Previous projects that company representatives mentioned in meetings as key developments in their portfolio, likewise did not appear to exist. This has led the partners to question the validity of the project. However it is possible, as has happened in other projects, that ground works are started, including the forest being cleared, but the project never materialized. Yet even reaching this point would bring serious damage to such an important and well-preserved area, namely by opening access to an area that is still isolated.

We undertook analysis of the proposed project location with biodiversity data. The map shows the critical importance of this area of the ONP for the 3 CR birds. We also undertook a review of the environmental legislation, which we combined with the spatial analysis and sent to the Environment Department and Prime Minister's cabinet as a short report. The key policies we reviewed included the, Regulation on the process of Environmental Impact Assessment - Decree no. 37/99. We found that the EIA contravened the regulation on a number of articles, including total failure to mention the biological value or legal protection of the project site or to identify direct, indirect and cumulative effects on fauna and flora and the protected area. In addition, we identified that this type of infrastructure project is incompatible with ONP - Law no. 6/06. The development as proposed contravenes the protection zones of the ONP as identified in the Management Plan, including the proposed location of reservoir occurring in zone P1, where only controlled use of medicinal species, accredited/authorised education trips with guides and construction of small tourism support structures are permitted. The development would also be contrary to the Convention on Biodiversity, which was ratified by STP on 29 September 1999 and the international commitments made through the Aichi targets.

Partners engaged in advocacy efforts with the country's Government. Discussions were very positive and BirdLife partners cultivated a positive reputation with some Government contacts. The environmental agenda has low profile within the Government, with (unsustainable) economic growth and development being favoured. BirdLife are however in a strong position for exerting influence on land-use planning issues, with our inputs being requested to the Environmental Impact Assessment process for the dam

and we have the technical information required to underpin this. We sent 3 communications to the Government regarding our concerns on the environmental impact of the proposed dam location, the illegality of the location and the extremely poor quality of the EIA. Project staff also attended 2 meetings with Government and TECHNIC staff, which showed that our communications to Government have got high profile. During the meetings, it was clear that the process for agreeing these developments is extremely convoluted and does not follow international standards.

Our main response to the EIA provided was one of serious concern about the legal and environmental viability of the development of any infrastructure within the ONP, which is an environmentally sensitive area, supporting many globally threatened endemic species, designated and protected by Law no. 6/06 and providing multiple key ecosystem services. We advocated that the EIA should not be accepted by the Environment Department and that if the principle of a dam development in the park cannot be rejected outright, then a new EIA should be prepared. Ultimately, we outlined that any project in the ONP would contravene the national law of STP, and so should be rejected by the Environment Department.

A new Government came into power over the last year. Since then this plan has not been mentioned and meetings with Government suggest this plan is on hold for now.

3.3 Oil-palm development impact and awareness raising progress

Oil-palm planting in riparian areas

BirdLife International's understanding is that Agripalma have been granted 3,000 ha of land for oil-palm concession in STP. These are allocated in the southern part of the island, outside the ONP, and are spread across 7 concession sites. As far as we are aware clearance of forest began in 2009, with the clearance of Ibis habitats occurring in 2010 and 2011. The preliminary SEIA was prepared in mid 2010, although the final version was not completed until mid 2011. The Monitoring Commission was established in 2013. The Agripalma concession sites fall within the lowland forest topographical zone of ST, which includes a mosaic of lowland primary forest, secondary degraded forest, and old plantations. The lowland forests of São Tomé support globally important biodiversity; are recognised as a globally important hotspot, and qualify in the top three most important forests in the world for forest bird conservation.

3.3.1. Assessment of oil-palm impact methods

Over the last 5 years, 7 surveys have been carried out by SPEA, the BirdLife Partner in Portugal, working with local field assistants, including ONP staff, and researchers from the University of Lisbon. These surveys have involved recording all endemic threatened biodiversity, with a focus on birds and plants. These surveys focused on the dry season periods. Data has been collated centrally into a digitised database and has been analysed using GIS mapping software. Landsat data has been combined with the field data to provide base maps and more information on land-use changes. Analysis has been carried out by RSPB, BirdLife Partner in the UK, and Ricardo F. de Lima, a researcher from the University of Lisbon. Additional socio-economic data collection has been initiated in 2015, by SPEA who have carried out interviews with hunters.

Impact of existing habitat loss

a. Distribution modelling, satellite data and ground truthing

Fieldwork and species distribution modelling suggests that neither the Fiscal nor the Grosbeak occur in oil palm concession sites. Surveys have not found these species present to the south of the natural park, almost certainly due to these areas being isolated and disturbed.

The picture is more concerning for the Dwarf Olive Ibis. The development of the Monte Carmo concession, in the south-eastern part of the ONP buffer zone, has led to the clearance of high quality forest habitat, upon which this species depended. This site was previously the best known stronghold for this species and is in an area where all three CR species could be reliably found. Field survey data collected from the site prior to the forest cuts in 2010, shows that it supported an important population of the CR Dwarf Olive Ibis (Fig. 32).

An analysis of changes in the likelihood of Ibis occupancy in the concessions, based on satellite image data compared between 2005 and 2013, shows that a minimum of 125 ha of suitable forest habitat for the Ibis, has been cleared (Fig. 32). Due to the presence of a concentration of endemic CR species, this cleared habitat would have qualified as High Conservation Value (HCV) Category 1, as defined by the RSPO. (RSPO definition: HCV 1 – Species diversity. Concentrations of biological diversity including endemic species, and rare, threatened or endangered species, that are significant at global, regional or national levels. Relevant RSPO principle and criteria 5.2, 7.1, 7.3

http://www.rspo.org/file/PnC_RSPO_Rev1.pdf).

An EIA and HCV Assessment, delivered by a qualified assessor, ought to have identified that these forests were HCV1 and enabled them to have been protected. On inspection of the preliminary Social and Environmental Impact Assessment (SEIA) that was carried out in late 2010, it was found to have been undertaken after cuts had started and was based on out of date information with low participation of external experts. BirdLife International, STP Government Environment Department, and in-country environmental NGOs were not made aware of any HCV assessment being undertaken.

The Dwarf Olive Ibis, thought to number less than 250 individuals, has been severely impacted by clearance at Monte Carmo, which has increased this species' risk of extinction. It is restricted to a narrow range of conditions (Fig. 32). Overall, analysis suggests that 20% of the potential distribution of the

species has either been lost, is at future risk of loss or will suffer from reduced suitability of the habitat due to disturbance from both current and expansion of oil palm developments (Fig. 32). This situation has however improved slightly, due to the later cancellation of the north-eastern concession (Santelmo), which would have been further detrimental for the Dwarf Olive Ibis.

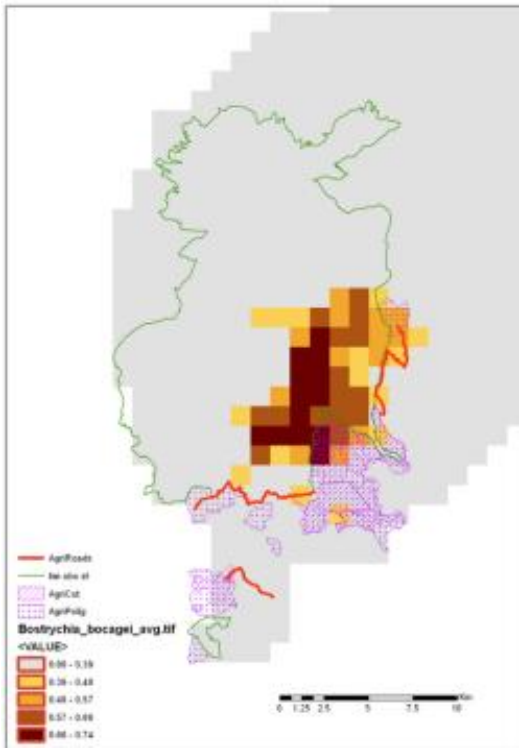


Figure 32 - Modelled distribution of the Critically Endangered Dwarf Olive Ibis. Purple polygons showing Agripalma concession areas, green outline showing natural park boundaries, red lines indicating associated road development, and coloured squares showing modelled species distribution with the darker colours representing higher suitability. Models built using maximum entropy modelling using remote sensing NDVI data, topography and climatic conditions are based on small sample sizes and remain unvalidated, but have a good fit to training data (AUC>0.9).

The Monte Carmo concession in the south-eastern part of the buffer zone was identified based on the old Emolve oil-palm plantation. Whilst it did mostly incorporate degraded forest with low biodiversity value, around the Monte Carmo area, an estimated 358 ha of lowland secondary forest was clear felled, around the existing old plantation, which was important for biodiversity. This estimate is at the minimum end of the scale. This was a previously known hotspot for the Dwarf Olive Ibis, and included a transect from the initial survey work, which was through the secondary old growth forest, which is now oil-palm plantation. Photographs are available from October 2010 from this concession of the forest cuts underway in this area.

The estimate of 358 ha of forest loss, inside the Monte Carmo region concession was made from satellite data, although surveys and ground-truthing have been carried out in addition as is documented. Landsat images from February 2010 and March 2015 were compared to identify areas where forest had been lost between those dates. Cloud cover was an issue, but the area of main focus was clear in these images,

and the images were geo referenced to each other (Fig. 33). Bands 3, 4, 5, and 7 were used from the Landsat ETM image from 2010 and bands 3, 4, 5, 6, 7 were used from the 2015 Landsat 8 image. These bands were stacked to produce one composite image with pixel size of 30 m. Unsupervised classification was run on this image to identify 20 broad and statistically distinct land cover classes. Visual inspection of the images indicated that one of these classes overlapped very clearly with the areas of forest clearance.

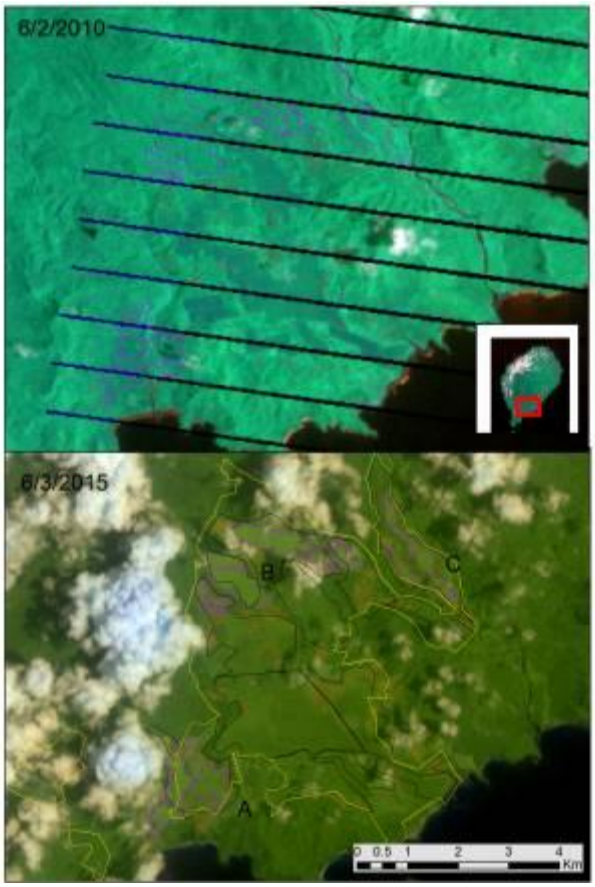


Figure 33 - Top image from February 2010, with blue boundaries outlining secondary lowland forest before clearance. Bottom landsat image from March 2015, with purple boundaries outlining secondary lowland forest post clearance labelled A,B and C, yellow boundary marking overall Monte Carmo concession digitised from cutting plans provided in 2013 and black boundaries outlining more detailed cutting plans and areas digitised from 2014.

Small areas of less than 0.5 ha were removed from the classification as these were likely to be noise. This left an area of 528 ha which appears to have been cleared of forest between 2010 and 2015. We cannot assess if this clearance was all for oil palm plantations as the plantations themselves are not visible yet and we do not have a complete map of the concessions. However, the extent of the clearance of the largest areas A, B and C on the map (Fig. 33) are all located inside the planned Monte Carmo concession, and were cleared for this plantation. These 3 areas total 358 ha.

b. Field survey distribution mapping and analysis

Mapping suggests that the Dwarf Olive Ibis is the most vulnerable CR bird, due to its concentrated distribution in the south-eastern area of the ONP and near the edge of the core protected area (Fig. 34). It is also the most threatened from large-scale forest clearance, due to its preference for the flatter terrain, which is also sought for agricultural projects.

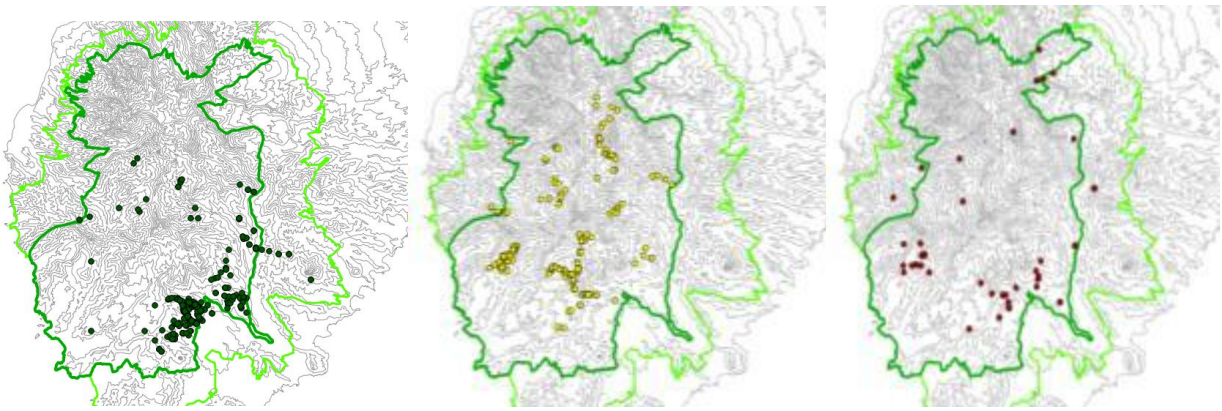


Figure 34 - Map of the records for the 3 Critically Endangered birds of São Tomé island. The green lines indicate Obô Natural Park boundaries (darker green = core park, lighter colour = buffer zone). Green records are for the Dwarf Olive Ibis, yellow records are for the São Tomé Fiscal and red records are for the São Tomé Grosbeak. Background black lines are 50m altitudinal isohyets.

c. Interviews with bird hunters

During interviews undertaken with 93 hunters who live in and around the buffer area of the protected area, 9 respondents mentioned that they had seen and hunted Ibis in areas of forest around Monte Carmo, Assentada Grande and Dona Eugénia, which has since been cleared by Agripalma for oil-palm. This was not in response to a specific question about oil-palm impact, but raised independently by the respondents. Respondents also explained how the oil-palm plantations were bad for the Dwarf Olive Ibis, which in response had moved further into the forest.

There is currently no information on the global population trend for the Dwarf Olive Ibis to understand how hunting or forest loss has affected the population numbers. However, whilst hunting is certainly a key threat to the species, leading to the direct mortality of individuals, the loss of a minimum of 125 ha of forest habitat for the Dwarf Olive Ibis will have had a significant impact on the global population of the species. In addition, the loss of this important forest habitat, associated with oil-palm development, will have led to an increase in the accessibility of previously protected parts of the species range, and in the hunting pressure, as outlined below.

Impact of habitat degradation and disturbance

In addition to the direct loss of suitable habitat from clearance for oil palm, there are two further areas of concern regarding the impact of oil palm concessions; fragmentation and disturbance.

The planned road developments for improving transportation between the concession areas are going to isolate the remaining Dwarf Olive Ibis populations outside the ONP. Of particular concern is the north-eastern road, which will separate a population of Ibis. These developments would effectively fragment

this population of the Dwarf Olive Ibis and reduce the connectivity of the forest habitat. Last meetings with Agripalma in early 2014, on this subject indicated that the construction of the north-eastern is not yet confirmed.

A further area of concern is disturbance, which is a much more difficult to quantify and monitor. The oil palm concessions will increase the level of disturbance to the birds in three main ways; 1) opening up road access will lead to increased accessibility for forest users, including illegal logging and hunting, into sensitive sites that were previously not accessed by these groups, 2) all three CR species distributions will have increased proximity to human activities, reducing the suitability of these habitats for the species, and 3)forest cuts will lead to the loss of buffer habitats, importantly around the ONP, which means a hardening of habitat edges. All this will lead to the reduced suitability of these areas for the species and degradation of the forest habitat. Evidence from field surveys confirmed that the Ibis does not occur south of the park, despite the existence of suitable habitat, likely due to human disturbance and hunting. There is already evidence of the loss of the species from still standing forest, where they were recorded in 2005, that are now affected by disturbance. The Dwarf Olive Ibis appears to have retreated into the ONP away from the cleared buffer zone to a distance of 1 km at certain sections.

Field visits in 2012 found evidence of increased logging inside the boundaries of the park by individuals from the Emolve community, that were using Agripalma equipment. In addition, palm wine collectors had moved a lot further into the park, after the forest they were originally exploring for palm wine had been cut in the buffer zone. This suggests increased habitat destruction and disturbance inside the park, occurring in one of the prime areas for the Dwarf Olive Ibis, as an indirect consequence of the Agripalma development. This situation continues, and was reported in meetings in January 2015 with the Forestry Department and with the Head of the Protect Area. Particularly, local people using the opened access to enter the Park and extract resources from the most strictly protected section of the Protected Area. An additional related concern is that local people are illegally logging old trees, left by Agripalma in the concessions and around the edges.

3.3.2. Governance, management, participation and transparency concerns

A SEIA was completed in July 2010 and a hard copy secured. However, the development started before the SEIA was prepared and publicly discussed. There was no mechanism for monitoring compliance with mitigation provisions in the SEIA recommendations for the first 3 years of the operations. The final SEIA was agreed by the ST Government in mid-2011, after cuts had been undertaken at the Monte Carmo concession. This does not meet with São Tomé s national legislation on EIA procedures.

Main findings from BirdLife International review of the preliminary SEIA in 2010, as we have not been provided with the final SEIA despite it being requested:

- It did not include any assessment of HCVAs, despite the concessions covering areas that definitely meet the criteria
- It did not include any useful biodiversity monitoring or survey
- There was no concrete reference to priority globally threatened species
- It was being prepared after the first forest cuts had been made

- It was not prepared in a participatory way and it was very difficult to access and to input to.

For the first 3 years of the development, operations continued on the ground without proper supervision, impact evaluation, or monitoring by the STP government authorities. There was no formal vetting and approval system before any further forest cuts were done. The Head of the Environment Department only had one paper map that was outdated when we met him in early 2013. They had requested budget from Agripalma to enable monitoring in the field, but this had not been provided. A Monitoring Commission was only setup in 2013, when the situation did improve. The Monitoring Commission focussed on trying to maintain small areas of forest inside the cut areas to preserve centenary trees and allow for some continuity in the landscape, as well as looking into restoring forest to offset the cut areas. The latter has still not been undertaken to the best of our knowledge, and such an activity would need a lot of specialist scientific research and restoration expertise, which have not been sought, to the best of our knowledge.

Despite several requests neither Agripalma nor Socfin provided information about the concession areas, future cutting plans, or the finalised SEIA, as was promised during meetings.

3.3.3. Impact of future habitat loss

An important finding from the forest survey fieldwork, was that the majority of the forest habitat in the planned concessions, was of apparently low conservation interest in terms of the three CR species. There is however evidence that cuts are underway outside sites covered by field work and considered in this report. From conversations with local stakeholders, we are aware that Agripalma has been granted permission to expand some parts of the concession sites in order to meet the 3,000 ha target. There is a lot of High Conservation Value Forest adjacent to many of the concessions, of particular concern is Monte Carmo, due to the proximity to the Dwarf Olive Ibis core population. It is therefore of high importance that survey work is undertaken in these new areas, to assess conservation value, prior to further cutting.

3.3.4. Working towards sustainable palm oil

Face to face meetings had been undertaken to attempt to divert planned oil palm expansion to places where it does not negatively impact on CR species or their habitat and to ensure that industry practices are minimizing negative impacts on the environment where possible. This has led to increased awareness of the importance of the concessions and surrounding areas for biodiversity.

Our key message has been that the clearance of this forest contravenes accepted international principles for more sustainable palm-oil development, including criteria 5.1 and 7.1. of the RSPO. These criteria mandate the identification, maintenance and enhancement of rare, threatened, and endangered species and other HCV habitats, and the completion of a comprehensive and participatory independent SEIA prior to establishing new plantings or operations. To BirdLife's knowledge, no HCV assessment of the STP concession areas was completed prior to clearance. In addition, the SEIA was completed after the clearance of this HCV forest, which goes against STP's national legislation.

RSPO, particularly Criteria 7, for example, focuses on the premise that new plantings from 2005 shall not have replaced primary forest or an area required to maintain high conservation values. Where this has

occurred without an adequate HCV assessment, it would be excluded from certification until an RSPO agreed compensation plan has been developed.

It should be noted that there are a number of industry initiatives underway to go beyond RSPO standard, for example, zero deforestation commitments made by leading palm oil and commodities traders, High Carbon Stock assessments, etc. The RSPO standard should therefore be considered as a minimum standard against which the environmental sustainability of palm oil developments in ST should be gauged. The IFC performance standard 6, particularly sections relating to protection of natural habitats and critical habitat for threatened species.

(http://www.ifc.org/wps/wcm/connect/bff0a28049a790d6b835faa8c6a8312a/PS6_English_2012.pdf?MOD=AJPERES)

BirdLife International have developed a set of recommendations to address the environmental impacts outlined here.

Oil-palm concessions bordering Obo Natural Park

3.3.5. Recommendations

BirdLife International has been in dialogue with Socfin and Agripalma, and the next step has been agreed as developing a plan of action for addressing the environmental concerns and to work towards improved implementation of the RSPO Principles and Criteria and other international standards for sustainable development. We have recommended that Socfin develops and implements, in collaboration with the appropriate stakeholders, a ST Forest Conservation Policy and Environmental Management Plan that reflects the international best practices that Socfin is seeking to implement in its worldwide operations, as well as the particular significance of ST as a global biodiversity hotspot. The Policy and Plan would focus on:

1. Sharing of information relating to location of planned cutting areas and road developments, so that BirdLife can offer advice on impact avoidance and mitigation relating to forest biodiversity.
2. Cessation of secondary forest clearance in all allocated concessions, until a thorough EIA including assessment of HCV areas by qualified third party assessors has been undertaken and publicly discussed as set out in STP national legislation.
3. Developing a compensation plan to address the loss of at least 358 ha of secondary forest habitat (defined as HCV Category 1 forest habitat as supporting concentrations of rare, threatened species of global significance). Mitigation measures need to include the calculation and consideration of

compensation liability and be approached on a like for like basis. BirdLife International recommends that the compensation mechanism supports the ONP Authority to enforce site protection at key sites for CR birds, including in the buffer zone, and supports forest restoration management at degraded sites important for CR birds and other endemic taxa within the Park and buffer zone.

4. Supporting the collection of essential, currently unavailable data, on how HCVs are currently and will be affected by any expansions of the concessions, based on the presence of globally threatened species, priority threatened habitats and ecosystems. Particular attention is needed in this regard, to the expansion of Monte Carmo concession and road developments. BirdLife can provide support to the design and implementation of the necessary data collection.

5. Assessing the impacts of the existing operations on the CR birds and other threatened species, and working to develop management solutions to resolve identified impacts, such as preventing access to environmentally sensitive areas and minimising opportunities for illegal logging and hunting. Depending on the output of the assessment, it also seems likely, based on our findings, that an agreed buffer zone needs to be put into operation around cuts on the Monte Carmo concession, where the site borders HCV habitat and the ONP.

We will be working with local partners and with Socfin and Agripalma over the following months to help support them in developing this policy and plan. The latest discussion with the Head of Operations of Agripalma has identified the following:

- Putting in place some measures, which whilst this shows a good commitment, we are unsure of their actual value for biodiversity ST profile is high within Socfin, whose Head of Sustainability is now pushing for top level measures for sustainability, particularly due to IFC funding support, who are also now pushing this case
- Recognition of the need to correct the mistakes occurring between 2010-2013

Forest demarcation and restoration priorities

In relation to activities 2,3 and 4 captured above, the partnership has produced the following 3 maps to provide site based recommendation for forest demarcation and restoration. These maps are based on an analysis of the distribution of potentially suitable habitat for dwarf olive ibis. We compared data on topography and land cover derived from satellite images at locations where ibis were recorded with random locations (assumed absences of the ibis). This process was done for a satellite image for 2005 and 2015 (i.e. pre and post cutting). A comparison of the areas identified as suitable in 2005, but unsuitable in 2013, was used to indicate the areas which should be restored as these represent areas from which forest which was formerly suitable was cleared.

The areas identified as suitable, based on the 2005 and 2013 images, were identified as the areas which should be retained. We recommend that 154ha of ibis habitat be restored. We also recommend that 453ha of forest within the concession be protected as this is important ibis habitat. This has been done based on outcomes from a meeting between Agripalma, BirdLife Partnership representatives and Rede Bio representatives in February 2016, which identified the interest from Agripalma in undertaking forest demarcation and restoration to compensate forest

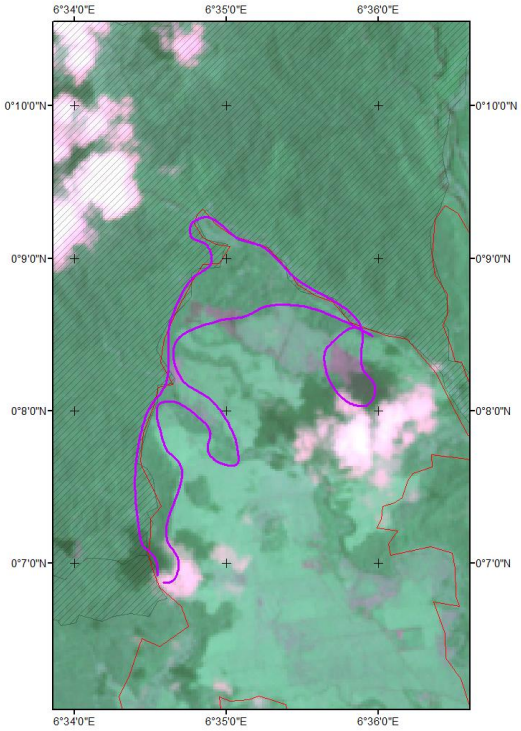
loss. It is essential that these activities are targeted in priority areas to ensure benefit for the High Conservation Value Forests that have been lost.

The BirdLife Partnership would also like to raise some important considerations in relation to forest restoration. Forest restoration is a resource intensive, long-term, complex and technically challenging activity, requiring a lot of expertise in order to really deliver High Conservation Value habitat. Particularly if this forest is going to be replacement for cleared forest that supported the Dwarf Olive Ibis. BirdLife welcome Agripalma's interest in such action and would therefore urge that engaging with experts in tropical forest restoration and targeting the action in specific areas would be essential in order to provide the compensation necessary for cleared forest areas, in line with RSPO. Forest demarcation and protection would provide a more immediate solution, to protecting remaining forest biodiversity, which is currently under urgent threat.

Alongside the priorities set out in the following maps, protection of forest in concession areas in Santo Antonio de Mussacavu, bordering Obo Natural Park is an important action, in order to avoid the issue of increased accessibility to sensitive areas by loggers and hunters, as has occurred in Monte Carmo.

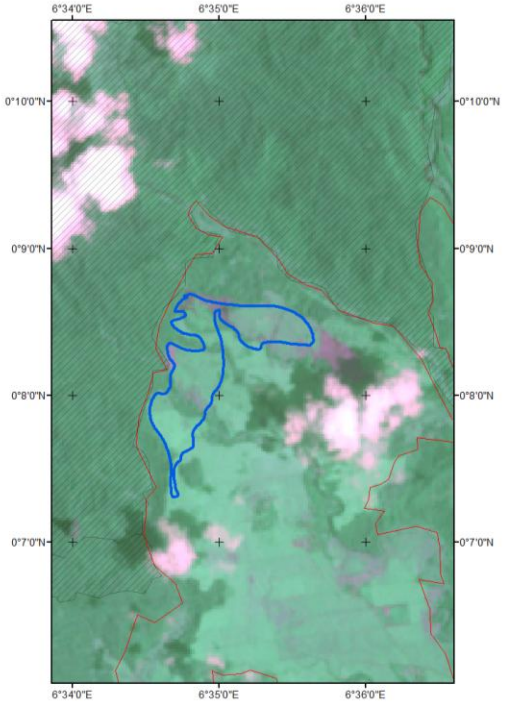
We look forward to further dialogue with Socfin and Agripalma about how they can best deliver their commitments to environmentally and socially responsible business including, minimising and mitigating its impact on the environment and transparent communication with relevant stakeholders, in order to enable progress towards meeting internationally accepted sustainability standards on all of their estates.

Priority HCV forest for demarcation, protection and restoration in Monte Carmo concession



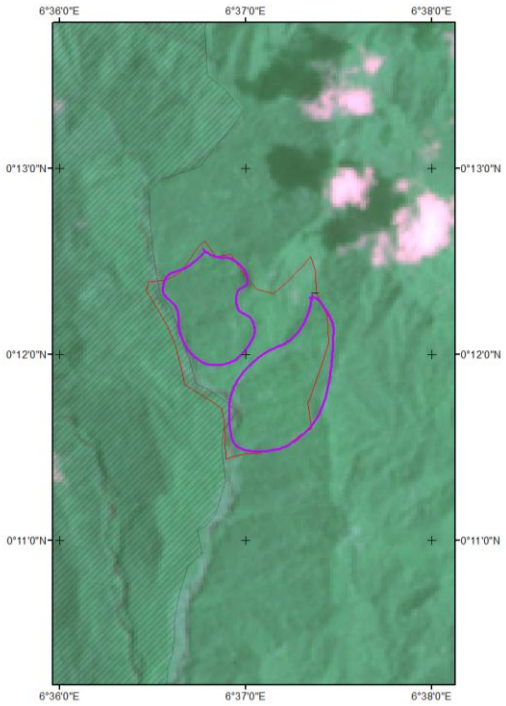
Map of Monte Carmo concession. Hatched area indicating Obo NP. Red polygon outlining Monte Carmo Concession extent. Purple polygon outlining priority HCV forest for demarcation, protection and restoration.

Priority area for targeting HCV forest restoration within Monte Carmo concession



Map of Monte Carmo concession. Hatched area indicating Obo NP. Red polygon outlining Monte Carmo Concession extent. Blue polygon outlining priority HCV forest for restoration.

Priority HCV forest for demarcation and protection in Santelmo concession



Map of Santelmo concession. Hatched area indicating Obo NP. Red polygon outlining Santelmo Concession extent. Pink polygon outlining priority HCV forest for protection and demarcation.

3.4 Government engagement and communications

Engagement with the Prime Minister

RSPB were invited to Chatham House Africa Programme roundtable: **São Tomé's International Relations and Resource Governance for Growth.** The roundtable was chaired by Dr Alex Vines OBE, Head of Africa Programme, Chatham House. HE Patrice Trovoada, STP Prime Minister was invited to celebrate the largest Santomean delegation ever coming to the UK.

Roundtable context

The archipelago of STP was recently granted a loan by the World Bank and the International Monetary Fund in support of the energy sector, the state budget and economic growth. With great potential and a promising oil sector, this significant cocoa producer faces challenges in catalysing sustainable growth and development. At this meeting HE Patrice Trovoada discussed his domestic and international priorities for São Tomé to place it securely on a path of economic diversification and sustained equitable growth.

Key discussion points

- The Prime Minister defined 2 geographic areas of focus for São Tomé island. The north, which is to be invested in to grow a sustainable economy, focussed on trading and industry development. The southern area including ONP is to be an area for protection and conservation.
- Flagged that any development needs to consider the environmental legislation and regulations in place.
- Recognition that the Government needs to invest in protecting New Frontiers Zone in south of island, particularly the ONP and to look at reforestation.
- Interested to look into eco-friendly construction to reduce unsustainable extraction of resources. 'São Tomé's trees are our African elephants, they are hunted for their precious value' recognising that preventing illegal logging is essential.
- Options for eco-tourism were also something the Government were interested in exploring
- Cocoa was identified as priority export. The Government were keen to promote ST as Chocolate Island, Although can't greatly increase production due to land pressures but wants to access high end markets. Sees this as being about sustainable development and supporting livelihoods rather than economic growth.

3.5 Meetings with Government Ministers and Directors

A series of meetings have been undertaken with the Director of Forests, General-Director for the Environment, Minister for Agriculture and Rural Development, and Minister for Public Infrastructure, Natural resources and Environment. This includes a larger annual review meeting, which aimed to review promote the project, highlight project progress and future plans. The purpose of these meetings was to discuss the conservation of forests and species of ST and to flag the top threats and options for addressing these threats. Key themes from these meetings are summarised below:

Other projects

Due to the small size of the country and the global importance of biodiversity, there were a number of larger-scale investments going into the country from World Bank, EU, GEF and other multi-lateral donors. Meetings with Government staff included updates and knowledge sharing on these investments, potential overlaps or collaborative opportunities for BirdLife efforts. There was also recognition that whilst there was a lot of development funding flowing into the country, the impact of this was not very clear on the ground, which was very concerning.

Hunting

Hunting was identified as an increasing threat. Lack of regulation and legislation is not helping, combined with lack of public awareness about the threatened status of some species. A Hunting law had been prepared but has been stalled for a number of years. Partners raised the importance of pushing this legislation forward and this was supported by the Minister for the Environment. In early 2016, the São Tomé Hunting Law was enacted (FAOLEX, 2016). This recent current legislation states that hunting licenses are required; it is illegal to hunt endangered species (including the Ibis); and forbids hunting in protected areas, i.e. São Tomé Obô Natural Park (FAOLEX, 2016). Penalties for offences in relation to this legislation are also detailed (FAOLEX, 2016). The current or potential impact of this legislation on the conservation of the endemic species of São Tomé is currently unknown. Similarly however, the planned communication of this legislation to the hunting community and enforcement of this legislation by the the ONP authorities/ Forestry Department is not known at present. Currently the approval of this Law has not been clearly communicated to the appropriate officials, and therefore it is unlikely to provide any benefits to the native wildlife in the short term.

Dam development

Following the elections of the new Government, the dam project on Yô Grande has stopped. Although, energy sector improvements likely to be one of the top priorities for the new Government. It is important project partners maintain our advocacy presence on this and ensure that proposals are not inside ONP and have strong EIA process. The Director for the Environment had a meeting with the Prime Minister and pushed this messaging and also raising that it would be valuable to have the project partners included in the process for any future dam and EIA development.

Illegal logging

Illegal logging was identified as a very big and increasing problem, particularly in the south of the island, in part driven by increasing access provided by the larger agricultural concessions managed by Agripalma and SATOCAO. Very high ranking and influential people have been associated with illegal logging. The market is unregulated and informal. The major driver is increasing population and associated increasing housing construction, which are built using a lot of timber, and forest clearance for agriculture. Methods discussed to address illegal logging included:

- Improved enforcement and surveillance
- Ensuring that all of the extracted timber is utilised and leaving as little waste products as possible

- Undertaking public awareness raising campaigns with communities on the importance of conserving forest resources
- Promotions of alternative energy sources and construction sources
- More investment in afforestation, particularly for providing woodlots for communities to reduce pressure

This is a top priority for the Prime Minister in terms of the Environment, and therefore partners will be aiming to push this agenda forward during all partner visits.

Agriculture

Getting time to meet with the Agriculture Ministry staff, proved more difficult than the staff in the more clearly biodiversity relevant Departments. The Agriculture staff were less aware of environmental issues, and did not always understand the link between agriculture and biodiversity and potential negative impacts. There were very different views on the larger commercial agricultural companies, between the different staff we spoke with. We also used these meetings to discuss concerns about the oil-palm developments, and get updates from the Government's perspectives.

Meeting with the General Director for the Environment

3.6 Meetings and workshop with Park Authority and regarding Park implementation

Several workshops and meetings were held to discuss the challenges and obstacles for ONP.

Group discussions on challenges faced by Obo Natural Park

Key points that were identified included:

- Limited numbers of Park staff
- Very small budget for the Park
- Poor coordination between the key Government Departments
- Lack of surveillance
- Lack of transport
- Lack of community engagement in the Park management
- Lack of support from Agriculture Ministry
- Illegal logging and difficulties in addressing this issue

Actions identified for improvement of Park implementation:

- Increasing Park budget, identification of sustainable financing mechanisms
- Increasing Park staff capacity on technical aspects of park management
- Development of strategic management partnerships
- More work and investment in awareness raising with communities and using different and relevant local media
- Investment in surveillance and enforcement of the Park
- Engagement of communities in Park management, through Community Forest Management

- Promotion and development of sustainable tourism for financing of the Park – particularly for surveillance
- Regulation of hunting and control of illegal logging
- Increase Government capacity for fundraising and project management

The outcomes of these discussions will also be included within the Review of the Management Plan of the park.

Two meetings were held with the Head of Park. During these meetings discussion centred around the issue of very restricting budget. Also, very limited staff number (only 6) and capacity is a major barrier for implementation. A biologist and technical forest expert are key missing staff as well as no capacity for surveillance and enforcement. Park priorities were identified as developing strong management partnership; maintenance and development of visitor infrastructure; public awareness raising with communities to reduce human pressure; and raising awareness of park protection and law and the review of the park management plan. The Park Authority were committed to conserving the CR species, and for integrating the outcomes of the project into the management plan review. However, the lack of capacity and resources for implementing the Park Management plan itself, was concerning in terms of their ability for undertaking additional actions for species.

The project partnership are now looking at building a large strategic funding partnership to invest in the significant growth and development of the ONP, to ensure it's implementation as the key strategy for conserving priority forest biodiversity in the country.

Zonation

Management Plans for Obo Natural Park and Principe Natural Park have been revised for implementation during the period of 2015-2020. However this revision has weakened the level of protection of the forest areas of utmost importance for the most threatened species, which the park was established to protect; and has weakened the level of protection of the forest areas most under pressure from illegal activities, such as logging and hunting (Fig. 35).

Besides, during the preparation of the new management plan, the Project Partnership had two discussions with the consultant leading the review of the Management Plan and zonation. During these meetings and through email follow-up, we shared our information relating to the species distributions, and the important areas of forest needing protection. We were therefore surprised that the final outcome of the new zonation, did not meet the requirements of protecting the three critically endangered bird species nor most important forest areas.

Project team warned government staff during meetings held in February 2016. They accepted our concerns and advised us to propose an amendment to the new management plan regarding zonation of the Obo Natural Park, which was sent by letter to the General-Director for the Environment and to the OBO Natural Park Authority. A map of the proposed zonation that was included in the amendment letter can be seen in figure 35.

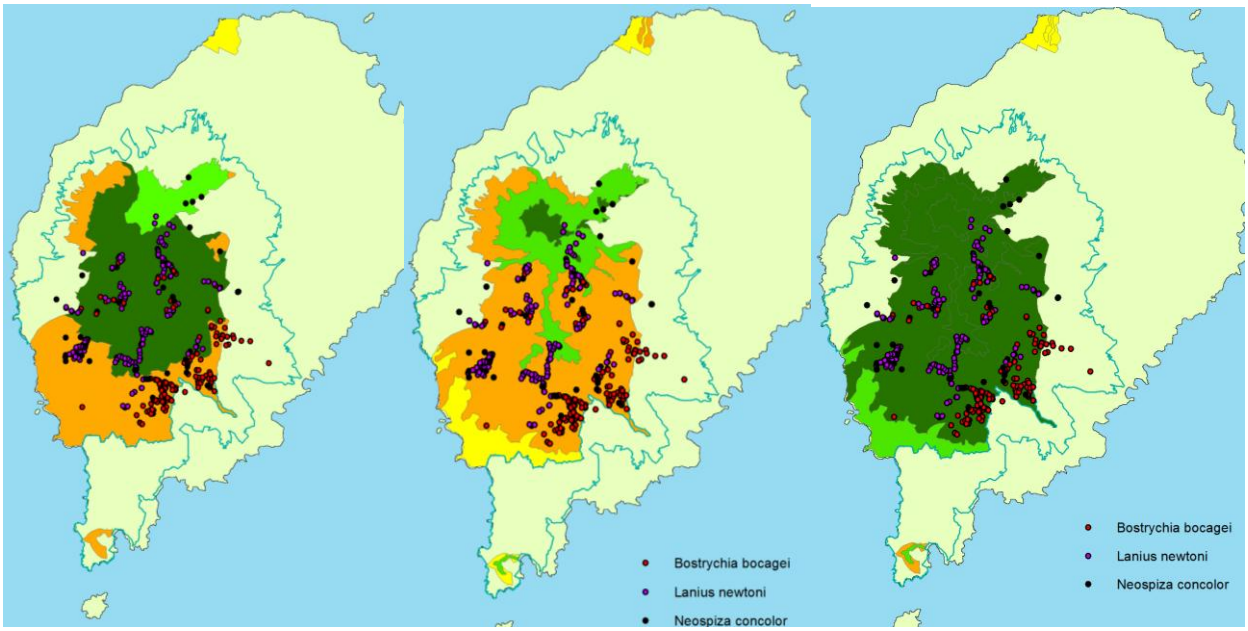


Figure 35 - Maps of the original ONP zonation (left), revised zonation for 2015/20 (middle) and zonation proposed by Project Partnership (right), including records for the São Tomé Fiscal (purple dots), São Tomé Grosbeak (black dots) and Dwarf Olive Ibis (red dots). Partial Protection II in yellow, Partial Protection I in orange, Total Protection II in light green and Total Protection I in dark green.

3.7 Building support for conservation of the unique biodiversity of São Tomé Island

This 10,000.00 GBP project was funded by Synchronicity Earth and implemented in 2016-2017 by a partnership between BirdLife International, SPEA and Oikos, cooperação e desenvolvimento.

Overview/Background:

São Tomé and Principe is often described as 'Africa's Galapagos' owing to its unique biodiversity. The islands' high biodiversity endemism, combined with their small size and the limited populations of those endemic species, make the islands' remarkable biodiversity highly vulnerable to continuing threats from poorly planned agricultural development, possible future hydro-power dam development, illegal wood logging, invasive species, uncontrolled extraction of Non-Timber Forest Products (NTFPs) and hunting. BirdLife is committed to safeguarding São Tomé's threatened biodiversity and conservation efforts have centred on field research to understand the status, needs and threats to STP's 3 critically endangered endemic bird species to inform species and forest conservation plans; advocacy at government and private sector level to improve the management and protection of Obo Natural Park; capacity building to grow local and national conservation expertise; and initial awareness raising amongst local communities of the importance of STP's biodiversity and ecosystems.

Aim of the Project:

To raise mass youth awareness of the global importance of the national birds of São Tomé and Principe, building on earlier communications results, to create a supportive environment for future large-scale conservation and community/livelihood development initiatives.

Overall expected outcomes

Increased awareness of the importance of the birds and biodiversity of São Tomé amongst young people engaged in the campaign development; schoolchildren reached through the pilot education programme and Nature Club; and general public through high profile promotion.

Youth advocates for conservation within local communities.

Figure 36 - Some of the activities developed during the project: awareness session at school in buffer zone of ONP; radio interview to divulge the campaign, the music and the importance of endemic biodiversity; dance group performing; Porto Alegre Nature Club activities in the Malanza mangrove and in the surroundings of Jalé.

Outputs

Table 17 - Expected outputs, implemented activities and achieved indicators of the project.

Expected outputs	**Implemented Activities**	**Achieved indicators**
A music and dance-based environmental awareness campaign developed through large-scale engagement of Santomean youth and capitalising on the profile of nationally recognised musicians/performers	- Mobilization of the national musicians Association – ASSOMUSICOS to cover creative aspects (music, dance, video); - Music composed and recorded at a local studio, and a Dance teacher mobilized to create the dance steps; - Interview given by Oikos and SPEA at the National Radio to present the project and its partners, and announce the Awareness Campaign for the month of April and May; - Steps taught to professional dancers to appear in the video clip, and to a group of 9 students, ages between 8 and 10, from ARCAR school, establishment ran by an NGO with a focus on orphans and children with family problems; - Dance group performed in the education program at the schools in the buffer zone of ONP.	- Original song and video clip produced, with participation of popular dancers from both islands. Lyrics in 4 distinct local dialects; - Song distributed at the National Radio and the Principe Regional Radio for 5 weeks coverage, as well as among taxis and music dealers in the capital; - Dance steps created and taught to a group of children as well as professional dancers; - Outfits made for the children and adult dancers, with designs and colours inspired by local birds; - Video clip broadcasted by local TV; - Meeting organized with the dance group, to present photos and videos taken during the shows, and distribute certificates of participation as well as a school kit to thank them for their dedication and participation in this project.
A pilot schools education program on biodiversity conservation and associated materials that can be rolled out as resources allow.	- Contacts made with 7 schools in the buffer zone of the ONP (Santa Catarina, Monte Café, Diogo Vaz, Agua Izé, Angolares, Morro Peixe and Porto Alegre) to conduct an awareness campaign on the importance of STP Biodiversity and Birds, targeting 5th grade (age 9-10); - Detailed program of activities designed for the sessions to be held in each school, including: (1) PowerPoint presentation on natural history and biodiversity of the islands, (2) PowerPoint presentation on the Importance of Birds in STP, and bird-song identification game for the participating students, (3) Presentation of the music and dance steps by the dance group, (4) closing words and snacks with participants;	- Radio interview recording, educational materials, photos and video coverage of the sessions available; - Total of 6 schools reached by the campaign (Santa Catarina, Monte Café, Diogo Vaz, Agua Izé, Angolares and Morro Peixe), with an average participation of 50 students per school, + teachers; - Closing event of the campaign on June 2nd at the school of Porto Alegre, District of Caué: *Opening presentation* by Oikos Animator: context of the campaign, importance of birds and song recognition exercise + debate; P*resentations by the students of the Nature Club* about their experience as they discovered and practiced Ornithology in April and May. In groups, students presented power point presentations to the audience, as if they were presenting the results of an investigation + questions; *Music and Dance presentation* by the Dance group; *Lunch*

	- Animator trained by OIKOS to conduct the awareness sessions at each school. Additional equipment were lent by local NGO MARAPA, including generator + data show.	with all the participants; - Attendance at the final presentation of approximately 70 people, most of them students, teachers and school staff. Parents of 3 of the Nature Club group also participated in the event; - Special invitations sent to the General Direction of Environment and local District Authority to attend the event, as well as to the journalists of the national TV station. However, only the Local District was able to have someone attending the event; - Letters sent by Oikos to each of the 7 targeted schools to thank them for their engagement, and ask them to fill in a short questionnaire to provide feedback on their impressions and opinion about the activit; - Each school has received a package, including copies of the pictures taken and the produced educational materials, so they can be shown to the kids and professors, and keep them as archive.
Nature Club established & mobilised in minimum one school in the buffer zone of Obo NP	- Contacts established with the Secondary School of Porto Alegre, as well as with the Ministry of Education regarding the establishment of a Nature Club and the realization of extra-curricular activities in Porto Alegre; - 6 students selected by their teachers at the school; - Program of activities designed including (1) introduction to create the club at the school, (2) field trip to the mangrove of Malanza in the ONP by boat, (3) field trip to Jalé beach and surrounding plantations, (4) work session on collected data and results, and preparation of the "*1st School Ornithology Conference in Porto Alegre*", to be held on June 2nd as part of the Children's Day celebration week; - Specific material produced for the Club, including a PowerPoint presentation on ornithology and research in general, to promote interest in scientific research.	- Authorization obtained by the Ministry to create the Club and organize extra-curricular activities with the children; - Photos, video coverage of the sessions and data sheets filled by the students during the field trips available; - The final Ornithology Conference took place on June 2nd at the school of Porto Alegre, in presence of other students, teachers, parents and local community leaders.

Objective 4: An annual monitoring programme is established to collect data on abundance and distribution of globally threatened birds and national capacity is developed to sustain it.

Significant progress has been made towards building capacity of the local field teams to undertake monitoring and field activities independently. In field training, undertaken during the survey work, in the survey methodologies, and using of GPS equipment and data recording have been very successful. Teams are now going into the field separately and doing the surveying and monitoring work independently, which is a very impressive achievement. Data outputs from this work are being included in the database and included for species status reviews. Increasing such technical capacity in the country is a top priority for delivering large-scale conservation initiatives and the skills being developed are a fundamental component for any future projects. This work also enables the individuals involved to engage in new employment opportunities, including working and providing technical skills for ONP. Further investment is needed to enable these field officers to get basic IT skills and manage data on computer programmes.

Lunch to thank the guides and partners

Monitoring programme

A methodology for monitoring forest biodiversity, resource extraction and main threats to the most important forests of the buffer zone and most accessible areas of the ONP has already been designed and implemented, as presented above in this report.

Data gathered from systematic surveys of ST's main forest block granted project team with knowledge of the most important areas for the endemic bird species, namely the 3 CR. A meeting will be held in the coming months to design the monitoring methodology that better suits each of the 3 CR and choose the most practicable areas/trails to be repeated regularly, taking into account some areas are too inaccessible.

Once the methodology is chosen, project team will also estimate the budget required for annual monitoring of the 3 CR and seek funding, as this is currently the most limiting factor for the implementation of a monitoring programme.

Monte Pico Association

Most experienced guides in forest habitat, bird surveys and in conducting field work for scientific studies, all belong to this association. Since its creation they have been implementing field work for projects reported in this document and to many other studies for ONP and foreign universities and have developed important skills as already referred above.

However Monte Pico is struggling with poor governance, and very low management and administrative capabilities, with most members without basic education. This has lead Project team to work with guides as individuals and not through the association, as we wouldn't rely on their financial management and wanted to guarantee that the guides involved in our research would receive a fair remuneration for their efforts and important achievements.

An important outcome would be to revive this association, once they have the most experienced guides. Additionally, granting further training to their members would help building capacity for them to be able to get more deeply involved in future conservation projects.

Recently project team had meeting, regarding future training opportunities, with various members of Monte Pico, who have been significantly involved in delivering field activities in the BirdLife Partnership programme, including Aristides Santana, Gabriel Cabinda, Gabriel Oquiongo and Sedney Samba. They referred the following as knowledge gaps and priorities for future training:

- basic education, as most of them had to quit school too early;
- computers and IT, namely for data entry;
- development of project proposals and reporting;
- administrative, management and coordination skills;
- further training on GPS and cartography interpretation, for field work planning and execution;
- botanic, as Estevão Soares and Faustino Oliveira are the most skilled but should pass their knowledge to others before retiring;
- foreign languages (english and french) for better receiving tourists and foreign scientists;
- interchange with conservation projects in other countries, as they think they would learn much from this.

Bird ringing training workshop

Local based, long-term bird ringing programs provide great benefits, including: i) accurate estimates of population parameters (e.g., survival rates, life-span), which are fundamental both from a purely scientific perspective but also for conservation management, and ii) the monitoring of the responses of communities to long-term changes in the environment. Besides this fundamental information, bird ringing programs can work very effectively as a tool for capacity-building, environmental education and public outreach (Şekercioğlu 2012).

Overall, long-term bird ringing programs based in areas of high conservation priority are an efficient and cost-effective tool, able to bring together science, conservation and the local communities (Şekercioğlu 2012).

The establishment of long-term bird ringing stations on STP has been contemplated as a way to monitor long-term changes in the communities in response to human activities and climate change (with evidence that rainfall patterns of the last decade have changed) while providing at the same time a tool for capacity building and environmental education. It has also considered as a cost-effective way of providing a regular source of extra income for those persons that have invested heavily in their formation in fieldwork techniques during the course of the last decade.

The main aim of this short course that took place between 12 and 14 July 2015 was to work with a small group of persons who could make the first core ringers able to take forward the implementation and running of bird ringing stations on ST Island. We needed to identify the persons that showed both an interest and enjoyment of the activity together with a technical ability to do it properly, field officers employed on the project made up a significant proportion of the 14 participants.

Bird ringing is foremost a practical technique. Except for a brief introduction to this activity (objectives, tools, bird welfare) all training was carried out in the field. Most students are farmers and hence are already quite 'practical' by experience. This meant that trainers could explain briefly what needed to be done at each step, and the students could do it themselves without the need for lengthy demonstrations. The course focused on:

1. Setting-up mist nets
2. Removing birds from the nets
3. Handling birds
4. Ringing
5. Measuring
6. Filling the data sheets

A bird ringing manual adapted for STP was put together for this course and will be a useful reference for future ringing on the islands.

The interest and engagement was high for all participants. Most were able to carry out most steps without major difficulties. An important quality for a ringer is patience and managing to keep calm under stressful situations – too many birds on the net, badly tangled bird, heat, mosquitos, hunger etc. It was not possible to assess people's capacity in this sense in such a short time.

Several participants of the course have since supported further ringing initiatives, which has helped developed their skills, including providing support to the São Tomé Fiscal study.

Finding people that are both good in the field and in data entry and curation will be critical if we are able to move forward on this work. The ability to keep and send the records is key and was not assessed during this course due to time constraints. Therefore the next steps for taking this work forward were identified as building capacity with data entry, data curation and data submission to appropriate ringing schemes to fully realise the value of this work.

Participants during the ringing training

Funds leveraged

The support from BirdLife International's Preventing Extinctions Programme, from the Prentice Family, as species champions for ST's Critically Endangered birds, as well as providing essential support to enable to the project to be developed, has been critical in leveraging further funds for the work. Additional funds of $25,000 USD have been raised through the USFWS, and a further $25,000 USD from the Disney Worldwide Conservation Fund as matched funding for the project outlined in this report. Finally 10,000 GBP have been granted by Synchronicity Earth to raise mass youth awareness of the global importance of the national birds of São Tomé and Principe.

In addition off the back of this project, 3 future initiatives are currently being developed:

1) Negotiations are underway with the Rainforest Trust to confirm their support of $190,000 for a 4 year programme focussed on building cross-sectoral partnerships for delivering forest protection and sustainable management in the buffer zone of the protected area.
2) Discussions are in hand with the European Commission Department for Development and Cooperation for a EUR 2.2 million, 5 year programme, focussed on investment into ONP implementation and sustainable financing development.
3) Call for submission of large grants to the Critical Ecosystems Partnership Fund will open in the upcoming months and a project will be submitted by project team to guarantee the implementation of priority actions for the conservation of the CR species.

Acknowledgements

The project partnership would like to sincerely thank the Prentice Family, for their support for the project as part of BirdLife's Species Champion Programme, which is absolutely critical and has enabled all the activities reported on here. The project partnership would also like to recognise the extremely hard work and dedication of the local field assistants; Gabriel Cabinda (Yeli), Ricardo Fonseca (Mito), Sedney Samba (Dulay), Leonel Viegas, Estevão Soares, Aristides Santana (Nity), Gabriel Oquiongo, Joel Oquiongo and Nelson who have made such fantastic contributions to science with their work in the field, led and supported by Hugo Sampaio and Ricardo de Lima, who have been the drivers of this project on the ground and without whom we would not be in the position we are today. The project would not have been possible without the help of many Santomeans we would like to make a special mention to Silvino Dias, José Malé, Filipe Santiago, Lidiney. We would also like to make a special dedication to the late Dakubala.

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