# Darwin Initiative Main Annual Report

To be completed with reference to the "Writing a Darwin/IWT Report" Information Note: (https://www.darwininitiative.org.uk/resources-for-projects/reporting-forms-change-request-forms-and-terms-and-conditions/).

It is expected that this report will be a **maximum** of 20 pages in length, excluding annexes)

**Submission Deadline: 30th April 2021**

## Darwin Project Information

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| Project reference | 26-018 |
| Project title | **Promoting public health in a biodiverse agroforest landscape in Guinea-Bissau** |
| Country/ies | Guinea-Bissau |
| Lead organisation | University of Exeter |
| Partner institution(s) | Institute for Biodiversity and Protected Areas (IBAP), Guinea-Bissau;<br><br>Associação Nacional para o Desenvolvimento Local e Urbano (NADEL), Guinea-Bissau;<br><br>Robert Koch Institute (RKI), Germany;<br><br>Centre for Research in Anthropology (CRIA), Portugal |
| Darwin grant value | £ 325,043.2 |
| Start/end dates of project | 01.07.2019 – 30.06.2022 |
| Reporting period (e.g. Apr 2020 – Mar 2021) and number (e.g. Annual Report 1, 2, 3) | July 2020 – Mar 2021<br>Annual Report 2 |
| Project Leader name | Dr. Kimberley Hockings |
| Project website/blog/social media | @KJHockings @hellen wildlife |
| Report author(s) and date | PL Hockings and DRF Bersacola wrote the report with contributions from project partners. 14th May 2021 |

## 1. Project summary

The ongoing outbreaks of Ebola and Covid-19 highlight one of the greatest challenges that we will face this century: the threat of emerging infectious diseases. These can represent serious risks to public health, and conservation problems when animal reservoir species are endangered. Zoonotic diseases are predicted to increase due to habitat destruction, road building and hunting, especially as some wildlife shift their distributions to utilise human-impacted habitats. The risks in less economically developed countries are high as they often lack the systems to detect and respond to outbreaks. Guinea-Bissau, West Africa, is among the poorest countries with 67% population living below $1.90 USD/day and many without access to healthcare. Cantanhez National Park is 1067km$^2$ and is inhabited by approximately 28,000 people. It is the country's most biodiverse protected area, with numerous threatened species such as the chimpanzee and red colobus monkey persisting within forest fragments surrounded by human settlements.

In April 2018, we identified incidences of leprosy (*Mycobacterium leprae*) in Critically Endangered chimpanzees at Cantanhez NP; the first in wild great apes (Fig1a). Although leprosy is present in humans in Guinea-Bissau, no data exist for human cases within Cantanhez NP. Our camera footage shows that other primates, which are commonly hunted for food and kept as pets, are also likely to be infected with leprosy (Fig1b). Such incidence of leprosy in several primate species of Cantanhez NP mean that poor people and wildlife are both at risk, either because of potential cross-infections or through retaliatory wildlife killings. This is compounded by a lack of knowledge about disease and behaviours that might influence the spread of disease.

The project's objectives are to: (1) evaluate the occurrence of leprosy in nonhuman primates and humans; (2) improve surveillance capacity for early- stage leprosy by the local health system; (3) work with NGOs, health practitioners and local communities to develop and trial a One Health awareness campaign; (4) make progress towards developing a multi-stakeholder preparedness and response plan for disease outbreaks and conservation conflicts over disease, and; (5) improve longer-term conservation capacity of key habitat and biodiversity.

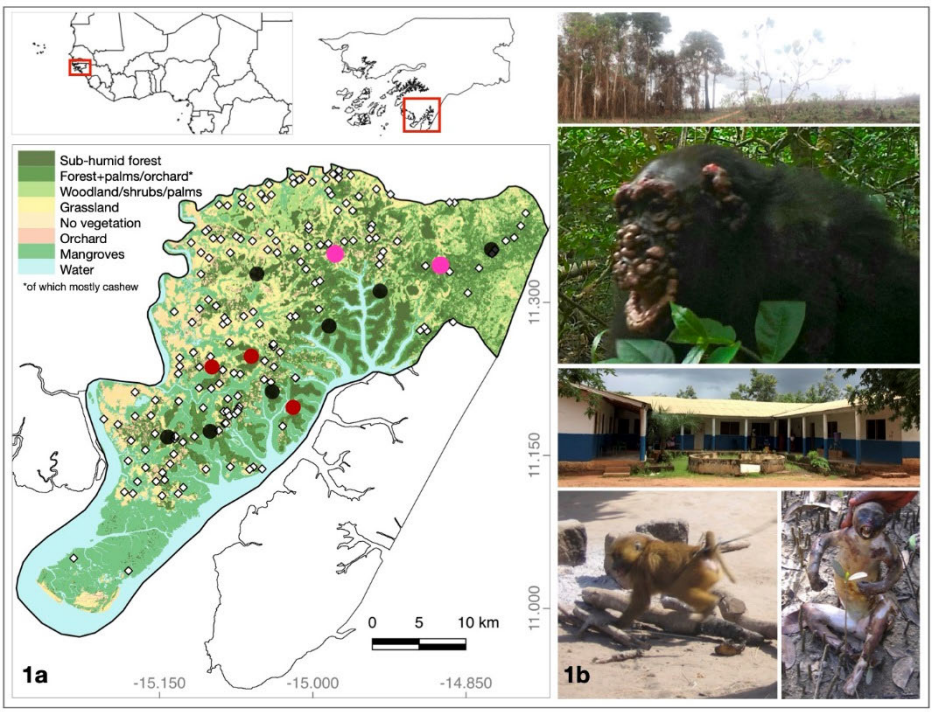


**Fig 1a** Map of Cantanhez National Park showing villages (white diamonds), and locations of known chimpanzee communities (black dots), including those with confirmed leprosy cases before this project (red dots) and those with leprosy cases identified during this project (pink dots, see **Output 2**).

**Fig 1b** Partially burned forest corridor next to a road and agricultural field. An adult female chimpanzee ("Brinkos") with leprosy. The hospital in Iemberem, includes three nurses who provide care to patients from at least twenty villages in central Cantanhez NP. Nonhuman primates, including baboons and red colobus monkeys, are often hunted for meat and kept as pets.

## 2. Project partnerships

Following the confirmation of leprosy in wild chimpanzees in Cantanhez NP, we discussed the situation with the Institute for Biodiversity and Protected Areas (IBAP), Guinea-Bissau, who are in charge of managing biodiversity and Protected Areas in Guinea-Bissau. Our discussions included ways to reduce the negative impacts of leprosy on endangered wildlife and the local human population. This collaborative project was consequently developed at the invitation of IBAP to respond to a potential health emergency resultant from the discovery of leprosy in chimpanzees and concern that it might result in conflicts with local people. Several representatives from partner Institutions and Organisations in Guinea-Bissau and Europe were involved in identifying and designing research, conservation, and development priorities. Project partners decided that to avoid creating panic and to enable us to properly advise health authorities about leprosy in chimpanzees and risk to local communities, we would collect crucial information prior to discussions with the Ministry of Health and the WHO in Guinea-Bissau. All partners are directly involved in planning and making decisions about project activities, with UoE coordinating the research, monitoring and evaluation activities.

IBAP is our main host partner, and we have worked closely with Abílio Said (Coordinator Dep. Terrestrial Protected Areas and CBS focal point in Guinea-Bissau), Aissa Regalla (Coordinator Dep. Monitoring and Biodiversity Conservation), Queba Quecuta (Director of Cantanhez NP) to ensure the timely completion of activities implemented *in situ* by the DPOs (Maimuna Jaló and Américo Sanhá), eight DFOs and two local research consultants (RCs). IBAP provided essential logistical support in-country including transport to and within Cantanhez NP; advised on biodiversity survey protocols; facilitated meetings and workshops; received funds to pay staff and complete project activities; assisted and advised on day-to-day activities on the ground.

We have worked with our Guinean partner NGO NADEL (Associação Nacional para o Desenvolvimento Local e Urbano), including Sidi Jaquite (NADEL Director), Aristoteles Gomes (NADEL National Coordinator) and Samba Tenem Camará (DPO) to adapt and develop a locally appropriate social science survey to determine local knowledge and perceptions of infectious diseases in Cantanhez NP and gather background information on the health system and health services available in Guinea-Bissau.

Once the project was equipped with this information (Year 1), IBAP and NADEL acted as a key liaison with partners as well as facilitating meetings with other Institutions, such as AIFO (Italian NGO that specialises on combating leprosy), Cumura Hospital (the referral hospital for leprosy in Guinea-Bissau) and a Guinean WHO representative, to develop the health campaign (Output 1) and response strategy (Output 4) in Year 2.

Our partner, the Centro em Rede de Investigação em Antropologia (CRIA), including Amélia Frazão-Moreira and Hannah Parathian, have worked with NADEL and UoE to develop social science methods to evaluate medical and traditional knowledge about leprosy and other disease. CRIA have been working alongside NADEL to ensure a culturally sensitive approach when collecting interview data and have advised on participatory approaches to ensure that women's opinions are included in the development of our project Output 1 and 3. They have provided theoretical context to increase our understanding around human health and behaviour (based on the One Health concept), which recognises that better knowledge of the causes and consequences of certain human activities, perceptions and behaviours in ecosystems is crucial for a rigorous interpretation of disease dynamics and to drive public policies.

Our partner, the Robert Kock Institute (RKI), is working with UoE and IBAP to advise on the design of great ape disease monitoring in Cantanhez NP, including expert opinion on camera trap footage and sample collection, and how to categorise the severity of leprosy symptoms in chimpanzees and other primates using medical criteria. RKI have also developed protocol and training instructions for sampling primate carcasses. UoE, RKI, and IBAP have produced and submitted a manuscript entitled "*Leprosy in wild chimpanzees*" that is currently undergoing revision in the leading journal *Nature*.

While not formal project partners, local people in Cantanhez (represented by Nalu chieftains, Women's Associations, Land Management Committee, Youth Associations and elders) are playing a crucial role in supporting and advising on biodiversity conservation and healthcare matters in Cantanhez NP. IBAP, including Queba Quecuta and the DPOs, have remained in consultation with local communities throughout Year 2, distributing protective and cleaning

equipment to reduce the spread of COVID-19. More recently, IBAP have selected and employed six local collaborators to undertake intensive leprosy monitoring using faecal sampling and additional camera traps across three chimpanzee communities where we have identified leprosy (**Evidence 2.3 and 2.4**).

A fundamental part of our project is the consolidation of a multi-stakeholder, cross-disciplinary multi-institutional collaborative approach to promote conservation and human health in Cantanhez NP. Maintaining and strengthening the collaborative environment for project partners is therefore crucial for every aspect of our project. These strong collaborations have enabled us to drive an effective, coordinated response to the COVID-19 pandemic to ensure transmission risk to wildlife is reduced (through guard training by IBAP; a tourist disease education programme has also been developed by our team as part of a Darwin emergency COVID-19 grant), and that local people have up-to-date information (through NADEL).

## 3. Project progress

### 3.1 Progress in carrying out project Activities

**From March to April 2021, our project underwent an MTR evaluation. We have revised our logframe including outputs and activities in response to the assessor's comments (see Annex 2.1; Section 10). Although these are yet to be formally approved by Darwin (through a Change Request, to be submitted week commencing 17th May 2021), we have included the revised activities (highlighted as Revised Activity in blue text).**

### Activities towards Output 1 Public health campaign and clinical training

- In response to the COVID-19 pandemic, in March 2020 the Bissau-Guinean government implemented quarantine measures, including closing international borders and within-country travel restrictions, bans of large gatherings and compulsory use of masks in public. The pandemic forced us to revise our social data collection strategy several times and caused delays in data collection throughout Y2Q1-Q2. We have now revised this output and associated activities (for revised logframe, see **Annex 2.1**) to take account of MTR suggestions, project delays and new context with the COVID-19 and Ebola situations. These led to various response and awareness campaigns being recently carried out throughout Guinea-Bissau including Cantanhez NP.

- Household interviews to assess knowledge and perception of disease and health services (**Activity 1.2/Revised Activity 1.2**) was scheduled to be completed in September 2020 (Y2Q2). In Y2Q1-2 CRIA, UoE and NADEL revised and developed an alternative data collection strategy taking into account the Covid-19 situation and associated delays. Additional training to NADEL personnel was carried out by NADEL DPO in Y2Q3 to assist in data collection of household interviews. Household interviews were completed in December 2020. One-hundred and one household interviews were carried out using two questionnaires (51 and 50 participants for each questionnaire). One questionnaire focussed on assessing the knowledge of on five infectious diseases (Covid-19, common cold, leprosy, cholera, malaria). The other questionnaire focussed on perceptions of disease transmission risks. Both questionnaires included questions about the use of health services, with the second questionnaire including perceptions of health services (**Evidence 1.1**). Data were analysed in Y2Q4 by CRIA (**Evidence 1.2**). The Covid-19 campaign and data from the household interviews highlighted the need for a more participatory approach in target villages, and the need for multiple communication methods (radio and visual-based communication) to deliver health messages, which will be integrated into our revised One Health campaign strategy scheduled in Y3 (**Revised Activities 1.6 and 1.11**).

- Data collection with Cantanhez health workers to establish baseline data on knowledge of and capacity to identify infectious diseases (**Activity 1.2/Revised Activity 1.3**) began in Y1Q4. Data collection was revised in Y2 to focus on leprosy and include health agents (**Evidence 1.3**). Health agents are residents in villages with training on 'basic health', which includes treatment of minor injuries and diseases and in cases that need further medical attention, assist with first aid and accompany the patient to the nearest health centre. Health agents are often the first port of call for local patients. Nurse and health agent questionnaires were developed by UoE, CRIA and NADEL in Y2Q4 and are currently under revision by Dr Silvio Coelho (Cumura Hospital and COVID-19 and Ebola response High Commission). Pre-training data collection with nurses and health agents is scheduled to commence in Y3Q1 by NADEL DPO (**Revised Activity 1.3**).

- The strategy to develop the health campaign was discussed during various meetings in Y2Q3-4 with UoE, NADEL, IBAP and CRIA. An initial meeting to develop the public health campaign (**Activity 1.4/Revised Activity 1.6**) was carried out on the 11th of March 2021 (Y2Q4) with NADEL, CRIA and UoE (**Evidence 4.2**). Additional meetings in March 2021 were held with relevant organisations, including a consultant for the World Health Organisation (**WHO**), **Cumura Hospital**, which is the referral hospital that specialises in leprosy diagnosis and treatment, and **AIFO** (Italian Association Amici di Raoul Follereau), an Italian NGO involved in the National Program for Leprosy Control in Guinea-Bissau (more information: https://www.aifo.it/progetti-nel-mondo/programma-nazionale-lebbra/). This official meeting was an opportunity to discuss the project's findings on leprosy in chimpanzees and the implications for human health and potential conservation conflicts including retaliatory behaviour and negative attitudes towards chimpanzees (**Evidence 4.3**). Cumura and AIFO agreed to collaborate in our project activities, including information sharing and to establish the main messages for the One Health campaign (**Activity 1.4/Revised Activity 1.6**), train campaign personnel (**Activity 1.5/Revised Activity 10**, scheduled Y3Q3) and train health workers (**Activity 1.7/Revised Activity 1.9**, scheduled Y3Q2-3). The development of health and conservation messages for the campaign are ongoing by all project partners UoE, IBAP, CRIA, RKI and NADEL, with Cumura Hospital and the NGO Associazione Italiana Amici di Raoul Follereau (AIFO) focussing on messages about leprosy. All partners and collaborators agree that in the face of a global pandemic, our health campaign should focus on One Health messages, with leprosy used as an example zoonotic disease. The One-Health campaign will complement national efforts to raise awareness about Covid-19 and Ebola (campaigns implemented by NADEL).

## Activities towards Output 2 Biodiversity Monitoring Programme

- Training and refreshment training were performed throughout Y2 (**Activity 2.1/Revised Activity 2.1**). DPOs delivered training to DFOs and RCs on data collection following the Covid-19 health and safety protocol in Y2Q2 (**Evidence 2.1**). Refreshment training and trouble-shooting exercises on data import, export and sharing were carried out with DPOs throughout Y2 by the DRF remotely. DPOs delivered training to DFOs on habitat data collection every 100m along transects using GPS and datasheet in Y2Q3 (**Evidence 2.2**). Chimpanzee faecal collection and management training (part of **Activity 2.1**) were delivered by UoE PhD student Marina Ramon and DRF to IBAP DPOs (Y2Q4-Y3Q1, **Evidence 2.3 and 2.4**). RCs Iaia Tawél Camará and Mamadu Cassamá have already been trained in some of the faecal collection methods by DRF in 2018-2019. DPOs trained and worked with RCs to deliver faecal collection training to six local collaborators in April 2021 (Y3Q1).
- Survey sampling sites (64 transects and 48 camera traps) were established in Y1 (**Activity 2.2/Revised Activity 2.2**). Survey sampling sites are currently under revision based on data analysis (Y2Q4-Y3) and discussions with DPOs (Y2Q4). Additional transects in Y3 may be considered across the north of the park due to the low number of fresh chimpanzee nests compared to the high number of old chimpanzee nests

recorded. This was to be expected as less research has been conducted in the north of the Park and less is known about chimpanzee ranging patterns.

- Survey data collection by eight DFOs, 2 RCs coordinated by IBAP DPOs and DRF (**Activity 2.3/Revised Activity 2.3**) for the biodiversity monitoring programme (BMP) began in Y1Q4 and is scheduled for each dry season: (Season 1) January – July 2020; (Season 2) December 2020 – July 2021; (Season 3) December 2021 – June 2022. During the first survey season, transect data collection paused in March 2020 following the decision by IBAP to temporarily halt all research activities due to the potential risks of COVID-19 transmission to vulnerable local communities and wildlife. Transect survey activities resumed in May 2020 following conversations with IBAP about the need to continue research whilst minimising the risks of disease spread via the establishment of a strict hygiene protocol for data collection (**Evidence 2.1 and 2.5**).
  - **Season 1 BMP (January - July 2020)**: The total transect survey effort of the first biomonitoring season is 208km (137km in Y2, 71km in Y1) (**Evidence 2.6**). Camera traps remained operational throughout Y2Q1 until mid-July 2020, and were checked by the DPOs during transect surveys. The total camera trap sampling effort for the first survey season equalled to 7514 camera trap days. Of the 48 camera traps, five camera traps were stolen in Y2Q1. Despite speaking extensively to local communities about the presence and use of camera trap data, it is an unfortunate reality that they are sometimes damaged or go missing during scientific research. Eight camera traps were moved during the survey season. The number of survey sites during the first biomonitoring season was 54 (52 independent sites, see **Evidence 3.1**).
  - **Season 2 BMP (Dec 2020 - ongoing)**: The 43 camera traps were set up again in December 2020 by the DPOs, DFOs and RCs. Three cameras malfunctioned and recorded no data. The effort for Y2 Season 2 camera trap surveys is 4370 camera trap days from 40 camera trap sites. The expected effort for Season 2 camera trap surveys (which will end in July 2021) is c. 8000 camera trap days. Season 2 transect surveys started in January 2021 and 57 transects have been repeated three times each up to end of Y2 (192km of survey effort) (**Evidence 2.7**). Data collection on seven transects from Season 1 surveys had to be halted due to a local village chief refusing to give permission to work in his area of jurisdiction (one village and three small settlements). Conflict resolution meetings were held by IBAP to resolve the issue with the communities involved, and permission has now been granted by the residents and local chief.
- Health monitoring via faecal sampling and targeted leprosy monitoring using additional camera traps (part of **Activity 2.3/Revised Activity 2.6**) were delayed due to Covid-19 logistical challenges. Additional camera trap material (including 65x camera traps, 50x security cases, 100x locks, 3520x AA alkaline batteries 300x SD cards), survey equipment (5x GPSs), hard drives and faecal sampling material were delivered via DHL to Bissau in March 2021. These materials will support data collection for targeted leprosy monitoring (video-mode camera traps and faecal sampling in three chimpanzee communities) scheduled to commence in Y3Q1 (**Evidence 2.3 and 2.4**).
- BMP progress was monitored via data entry and sharing by IBAP DPOs and regular meetings between DPOs and DRF throughout Y2 (remotely, via WhatsApp calls) (**Activity 2.4/Revised Activity 2.4**). Transect survey data (Cybertracker, GPS, datasheets) were entered and processed in SMART (**Evidence 2.6 and 2.7**), Basecamp and Excel by IBAP DPOs. Data were shared by DPOs to DRF every 1-2 months during data collection. Camera trap summary data on Excel (number of photos per species, check-up dates) was shared by DPOs to DRF every 2-3 months during data collection periods (April 2020, May 2020, August 2020, and again in February 2021). Three reports (**Evidence 2.8, 2.9 and 2.10**) were written up by DPOs and shared with DRF in Y2 (April 2020, September/October 2020, March 2021).
- The first evaluation of the BMP (**Activity 2.6/Revised Activity 2.8**) started is in progress via data analysis. Analysis of Season 1 BMP includes distance sampling analysis by UoE and INLA-SPDE spatial modelling by DRF (**see Output 3**). Report

including summaries of data obtained written up and shared by DPOs in Y2Q3. Preliminary results were presented by DPOs during M&E meeting in Y2Q4 (**Evidence 2.11**). In Y2 we obtained new data on leprosy occurrence. Additional chimpanzee and baboon individuals with leprosy symptoms identified across the north of the park (**Evidence 2.12**).

## Activities towards Output 3 Human-wildlife interaction plan

- Data analysis (**Activity 3.1/Revised Activity 3.1**) began in Y2Q4 as scheduled. Spatial modelling using camera trap data started by DRF in Y2Q4 and is ongoing (**Evidence 3.1**). Analysis of BMP data will generate maps of wildlife abundance (six primates and five ungulates) and disease distribution (chimpanzee and baboon), which will be used to identify key corridors (areas connecting sites with high wildlife abundance) and hotspots of human-wildlife interactions (high human-wildlife overlap, including overlap with territories of animals with leprosy disease).
- Results from the wildlife models and social science interviews will inform an **additional activity** for this Output (not included in the original LogFrame, **Revised Activity 3.3**) scheduled for Y3. This activity will involve participatory mapping by trained DFOs at selected villages where leprosy in chimpanzees has been identified. Participatory mapping will include locations of resources shared between humans and wildlife (water sources, cultivated food sites, wild food sites) will be integrated to the wildlife maps to inform the development of the plan.
- Additional GIS layers, including health landmarks (graded health centres, health units, healers), and vegetation cover between 2017-2021, will be added to the drafted plan in Y3Q2.
- Maps will be shown and discussed by IBAP, NADEL and UoE during meetings with local stakeholders, including the management committee, women's groups, farmers and hunters (**Revised Activity 3.4**, scheduled to commence in Y3Q2). These meetings will be used to inform the content of the One Health environmental management plan. During meetings IBAP and UoE will facilitate discussions with stakeholders about the spatial overlap with wildlife, and gather participants' ideas for potential ways to mitigate health risks, for example avoiding direct encounters with chimpanzees, planting certain crop foods away from villages, washing wild and cultivated fruits before consumption, using human-only water sources, avoiding touching and handling primates, and avoiding touching wild animal carcasses found in the forest.

## Activities towards Output 4 Multi-stakeholder leprosy response plan

- The annual M&E meeting (**Activity 4.2/Revised Activity 4.2**) was carried out on 23rd of March 2021 with IBAP, NADEL, CRIA and UoE, over Zoom (originally scheduled to take place in Lisbon). RKI was unable to attend as Fabian Leendertz was part of the WHO COVID-19 response team. The PL held a separate meeting with RKI to ensure all information was shared. UoE DRF presented progress of Y2, including progress of activities under each Output. CRIA presented data obtained for Output 1, including interviews with nurses and traditional healers, and household interviews (**Evidence 4.1**). IBAP DPOs presented the data obtained from the first season of the BMP and preliminary results (**Evidence 2.11**). UoE DRF presented the timeline for Y3, including activities under each Output. Project partners discussed achievements and activities of Y2, as well as Y3 strategy for each Output and the schedule for regular partner meetings in Y3 (every two months).
- Progress to identify and engage relevant organisation focal points (**Activity 4.3/Revised Activity 4.3**) has been made via meetings with Dr Magda Robalo (Public Health Ministry, now **High Commission for the fight against Covid-19 and Ebola**), Dr Silvio

Coelho (**Cumura Hospital and High Commission for the fight against Covid-19 and Ebola**), Mireille Pereira (**WHO**) and Arniel Silot, Giovanni Gazzoli, Michele Falavigna and Elisabetta Quattrocchi (**AIFO**). Meetings were held on 19th and 22nd of March (Y2Q4) (**Evidence 4.2**). UoE PL presented research findings of leprosy in chimpanzees, which included up-to-date information on genetic analyses of the strain of *M. leprae* in Cantanhez NP, possible transmission pathways (environmental, human, animal), and progression of symptoms in affected individuals, as presented in the article preprint submitted to *Nature* (https://www.biorxiv.org/content/10.1101/2020.11.10.374371v1) (**Evidence 4.3**). This information generated discussions regarding the social and ecological context of leprosy in humans and wildlife in Cantanhez NP, and the direction of leprosy transmission. AIFO and Cumura shared their knowledge on leprosy in humans and the situation in Guinea-Bissau. UoE DRF presented the Outputs of the Darwin Project. Participants agreed to collaborate on our project, specifically in training of health workers and the public awareness campaign (Output 1),in the preparedness and response program (Output 4), and the use of a One Health approach that integrates the complexities of human-wildlife interactions (i.e. risks of conflicts, retaliatory killings) and the stigma surrounding leprosy disease in humans. This meeting was deliberately planned at a time when the Darwin team could answer questions on wildlife components of leprosy confidently due to successful data collection as part of Output 2.

- The workshop to develop the outbreak preparedness and response and human-wildlife conflict mitigation strategy (**Activity 4.4**) was originally scheduled for Y2Q4 but was delayed due to the COVID-19 situation. Due to the pandemic delays and following suggestions brought forward by the MTR, activities under this Output were revised (**Annex 2.1**). The development of the strategic plan to respond to disease outbreaks and conservation conflicts over disease in wildlife will be achieved through regular meetings (every four months) with project partners and health stakeholders (AIFO, Cumura, WHO) (**Revised Activity 4.4**), a collection of primary data regarding the occurrence of leprosy in Guinea-Bissau (**Revised Activity 4.5**), a review of Governmental and NGO leprosy and One Health strategies, awareness campaigns, health worker trainings and documentation of case management in Cumura Hospital (**Revised Activity 4.6**), review of communication chain for leprosy case detection and management (**Revised Activity 4.7**), a review of disease-related conservation conflicts (**Revised Activity 4.8**) and during a series of meetings in Y3Q3 (**Revised Activity 4.9**).

## 3.2 Progress towards project Outputs

Revisions were made to all Outputs in response to MTR comments as well as the COVID-19 and Ebola situation. **Although these are yet to be formally approved by Darwin, we have included the revised Outputs (highlighted as Revised Output and Revised Output Indicator in blue text).**

### Progress towards Output 1 Public health campaign and clinical training

**Original Output 1. Reduced risks of leprosy transmission/outbreak in humans and disease-related conflicts (e.g. retaliatory killing of wildlife) through an evidence-based public health campaign across Cantanhez NP.**

**Indicator 1.1** By the end of Y2, awareness campaign based on sociocultural data developed and implemented. By the end of Y3, at least 14,000 people (50% of the population including men and women) have engaged with campaign.

**Indicator 1.2** By Y2 high-risk behaviours that encourage disease transmission identified, and by the beginning of Y4 high-risk behaviours reduced by at least 50% (in 50 households) from baseline established in Y1.

**Indicator 1.3** By end of Y2, 80% health professionals at the 8 centres in Cantanhez have improved capacity to rapidly identify zoonotic disease, including leprosy.

**Indicator 1.4** By the end of Y3, public knowledge of zoonotic disease and transmission risks is improved in 90% of households (n=50), compared to Y1 baseline with less than 5% of households indicating negative perceptions of/attitudes towards wildlife concerning disease.

**Revised Output 1. Surveillance for leprosy disease in Cantanhez is increased and partner villages demonstrate improvement in understanding the links between environmental, animal and human health.**

**Revised Indicator 1.1** By the end of Y2, understanding of local knowledge and perceptions of disease is improved by at least 15% compared to baseline 5% (based on previous literature from Cantanhez NP) and potential risk factors for wildlife-to-humans disease transmissions are identified.

**Revised Indicator 1.2** By the middle of Y3, at least 80% of local nurses (N=6), health agents (N=50) and traditional healers (N=10) are trained to identify early symptoms of leprosy disease.

**Revised Indicator 1.3** By the end of Y3, at least 50% of campaign participants (N=30 out of 60, including at least 50% women) demonstrate increased understanding in the links between environmental, animal and human health via One Health trial campaign in six partner villages compared to baseline pre-campaign.

- Revisions were made in this Output as a result of the COVID-19 and Ebola situations, COVID-19 delays and in response to MTR comments. We originally planned to develop and implement a public health campaign across Cantanhez NP, involving at least 70 villages. Due to the COVID-19 and Ebola campaigns already underway across Guinea-Bissau, including Cantanhez NP (NADEL are involved in these), we made the decision to reduce the spatial scale of our campaign to selected villages, and adopt a One Health approach rather than focussing the campaign on a specific zoonotic disease. Instead our campaign will focus on One Health messages, with leprosy used as an example zoonotic disease. The reduction in scale was due to the complexities involved in delivering One Health concepts effectively and to trial messages in selected villages to avoid miscommunication, *particularly regarding the level of public health dangerousness of leprosy occurrence in wildlife for local people*. Our new One Health trial campaign approach allows us to explore and identify effective ways to deliver One Health messages, which will be incorporated into a One Health campaign strategy report for future application, including scaling-up to Park- and Regional-levels, by health and conservation institutions working in Guinea-Bissau (see **Revised Outcome Indicator 0.1**). Progress towards Output 1 Indicators, including Revised Indicators is detailed below.

- Progress towards **Output 1** was made in Y2 via social data collection and analysis (household interviews), revision of the leprosy national health program and Covid-19 and Ebola campaign strategies, and via zoom meetings with project partners and relevant organisations in Y2Q4.

- Data collection to understand local knowledge and perceptions of disease (**Indicator 1.1/Revised Indicator 1.1**) was completed via interviews with 101 household participants carried out in Y2Q3 by NADEL (**Evidence 1.1 and 1.2**). The interviews were originally planned to be used as baseline for the park-wise public health campaign. The revised plan will use data from these interviews to inform the campaign strategy at selected villages (pre-campaign baseline will be carried out with 60 participants) and to assess knowledge post-campaign across partner villages. **Key findings:** The majority of participants reported that they did not know if a zoonotic disease, including leprosy,

common cold, malaria, cholera and COVID-19 could affect animals (between 65 and 68% of respondents depending on the disease). Many participants did not believe that animals could be affected by these five diseases (25-29%). Sixty percent of participants (N=30) did not know if humans could catch a disease (any) from animals via the consumption of their meat. Twenty-six percent of participants (N=13) believed that humans can catch a disease from animals, including Ebola (2 respondents), skin diseases (3), Covid-19 (1) and tuberculosis (2). Half of participants did not know what they could do to reduce risks of getting a disease from an animal; 22% of participants believed there is nothing one could do to reduce risks. Of the participants that reported measures to mitigate zoonotic transmission risks (24%, N=12), avoiding the consumption of ill animals and keeping a distance were mentioned. When asked about what to do when encountering a dead animal in the forest, 54% of participants said they would bury it, implying it would be fine to handle the carcass of a wild animal not knowing its cause of death. These results highlighted the need for a One Health and inclusive approach for our campaign.

- Data collection to identify potential risk behaviours (**Indicator 1.2/ Revised Indicator 1.1**) was completed in Y2Q3 with the 101 household interviews across 27 villages. Data analysis was carried out by CRIA in Y2Q4. The risk factors identified, which included using waterpoints shared with wildlife, touching or handling wild animal carcasses, and consuming primate meat (**Evidence 1.2**) will inform the One Health campaign messages and will be used as examples in participatory discussions to identify ways to reduce health risks.

- Progress towards increased local surveillance for leprosy (**Revised Indicator 1.2**) was made through meetings with leprosy specialists at AIFO and Cumura Hospital. On the 19th of March, UoE, CRIA and NADEL met with AIFO representatives; the meeting was an opportunity to share Darwin Project aims and the work of AIFO and explore ways to collaborate. On the 22nd of March UoE, IBAP, NADEL and CRIA met with AIFO, Cumura Hospital/High Commission for Covid19 and Ebola response and the WHO to initiate collaboration and merge efforts in Cantanhez NP. In March 2021 Cumura Hospital were involved in outreach activities and training of local health force in the east of the country (Bafatá and Gabu) as part of their program to fight the plight of leprosy targeting priority regions (i.e. regions with highest leprosy incidence in humans). Our meeting was an opportunity to highlight Cantanhez as an important area of intervention due to the presence of leprosy in chimpanzees in Cantanhez NP and evidence from our research that suggests people transmitted leprosy to the chimpanzees. Cumura and AIFO have agreed to collaborate to achieve this Output, through engaging in specific activities (see above). Cumura and AIFO have agreed to work with the Darwin Project to provide training to health workers (nurses, health agents, healers) and advise on leprosy messaging for the One Health campaign.

- Progress towards assessing the local health force's capacity to identify infectious diseases (**Indicator 1.3/Revised Indicator 1.2**) have been slowed due to the COVID-19 pandemic and associated delays in data collection. Data collection to establish the baseline began in Y1Q4, with five nurses and five traditional healers interviewed. Data collection stopped during the first six months of the COVID-19 pandemic for safety reasons and due to health centres overloaded dealing with the COVID-19 response. Due to these delays, we now aim to achieve the pre-campaign baseline by Y3Q3 via additional interviews with at least six nurses, 50 health agents and 10 traditional healers carried out by NADEL DPO in Y3Q1-2. Training to local nurses, health agents and traditional healers is scheduled for Y3Q2-3. Training material is being developed with Cumura Hospital representative Dr Silvio Coelho and AIFO (human health). Training material will also include One Health concepts and messages about human-wildlife interactions, including the role of health workers in helping to mitigate risks of conservation conflicts over disease. The wildlife-related material is being developed first by UoE, IBAP and RKI, and will be finalised with NADEL, Cumura and AIFO.

- Progress towards developing the health campaign trial (**Revised Indicator 1.3**) now scheduled for Y3 was made via meetings with project partners in Y2Q3-4. On the 11th of March we held an initial workshop with UoE, CRIA, NADEL, presenting the results of the interviews. Our data suggested a lack of public awareness or willingness to share information about zoonotic diseases including COVID-19 (**Evidence 1.2**). During the meeting we therefore discussed the need for a more holistic approach for public health messaging, such as One Health, as well as an increased participatory approach such as training and discussion sessions with a selected group of residents (60 participants), and the use of theatre. During the meeting we also discussed ways in which leprosy in wildlife can be used as a disease example in One Health messages due to the highly visible characteristics of leprosy symptoms, particularly at advanced stages.

## Progress towards Output 2 Biodiversity Monitoring Programme

**Output 2. Improved wildlife management capacity through the establishment of the first health and abundance systematic monitoring programme for key terrestrial biodiversity in Guinea-Bissau.**

**Indicator 2.1** By Y2, the wildlife monitoring capacity in Cantanhez NP is increased by 100% compared to baseline zero. Eight DFOs and one DPO collect, enter and analyse data.

**Indicator 2.2** By the end of Y3, regular monitoring has improved knowledge of biodiversity and disease presence in 12 protected forest blocks (approximately 70km$^2$) across Cantanhez NP (including pilot data collected in 2018 - Halpin Urgency Grant).

**Indicator 2.3** By the beginning of Y4, monitoring programme evaluated and incorporated into IBAP's long- term management of Cantanhez NP.

**Output 2. Improved wildlife management capacity through the establishment of the first health and abundance systematic monitoring programme for key terrestrial biodiversity in Guinea-Bissau.**

**Revised Indicator 2.1** By Y2, the wildlife monitoring capacity in Cantanhez NP is increased to 80% compared to baseline 5% (based on number of park staff trained to record and analyse data, and existing training manuals).

**Revised Indicator 2.2** By the end of Y3, regular monitoring has improved knowledge of biodiversity and disease presence across Cantanhez NP, including 12 protected forest blocks (approximately 70km$^2$) compared to pre-project baseline 20% (including pilot data collected in 2018 - Halpin Urgency Grant and PhD data by DRF collected in 2016-2017).

**Revised Indicator 2.3** By the end of Y3, institutional capacity to sample, handle and dispose wild animal carcasses securely is increased by 100% compared to baseline zero.

**Revised Indicator 2.4** By the beginning of Y4, the biodiversity monitoring programme is evaluated and incorporated into IBAP's long-term management of Cantanhez NP.

- Increased wildlife monitoring capacity in Cantanhez NP (**Indicator 2.1/Revised Indicator 2.1**) has been achieved. Eight DFOs, two local research consultants (RCs) and two DPOs were trained in survey data collection in Y1 by the DRF. Covid-19 safety training was conducted by DPOs to 8 DFOs and 2 RCs in Y2Q1. Refreshment data collection training sessions were performed by DPOs to 8 DFOs and 2RCs at the start of the second season of the BMP. These included in Y2Q3 (habitat data collection, set

up and maintain camera traps, GPS use and fill datasheets) and Y2Q4 (transect data collection using GPS and Cybertracker). Progress was also demonstrated by data obtained by DFOs, data entered and shared by the DPOs, and report by the DPOs. DPOs were trained on data entry and management in Y1 by the DRF. Throughout Y2 the DRF assisted the DPOs remotely via phone meetings and emails. Data entered by DPOs and shared with DRF every 1-2 months (Excel tables and SMART data) in Y2Q1-2 for first monitoring season and again in Y2Q3-4 once data collection resumed for the second season. A total of 1011 observations of wildlife (incl. 185 direct observations of primates) and 320 observations of human activities have so far been recorded by the DFOs using CyberTracker (including Y1 and Y2). Distribution data of primates and ungulates were obtained (**Evidence 2.6, 2.7, 2.11 and 3.1**)**.** A report summarising the data collected during the first season of the BMP was written and shared by DPOs in Y2Q3 (**Evidence 2.9**). External hard drive containing all 2020 data including camera trap footage delivered to DRF in January 2021.

- Season 1 BMP activities (Y1Q4-Y2Q2), i.e. data collection and analysis, increased our knowledge on wildlife abundance and distribution and disease occurrence (**Indicator 2.2/Revised Indicator 2.2**). We obtained approximately 0.7 terabytes of season 1 biomonitoring camera trap data from 54 camera trap sites (48 camera traps, of which eight were moved into second locations and five were stolen) and associated information (GPS, deployment information) DPOs and DRF have reviewed 100% of camera trap data obtained in Y1Q4–Y2Q2. Data gathered in the first biomonitoring season include 6 months of camera trap data (7514 camera trap days), and 208km of transect survey effort. Data collection covered 540 $km^2$ in association with 13 forest blocks and four main corridor zones. **Key findings:** Leprosy disease occurrence was identified in the north of the park in three additional chimpanzee communities, with two individuals showing advanced stage leprosy, and three individuals showing possible signs. In Y2Q4 leprosy was confirmed in baboons at Caiquene (south Cantanhez) by laboratory analysis at RKI (**Evidence 2.13**). Based on camera trap images of baboons, leprosy was identified in three groups of baboons across the park, including the south and across the north of Cantanhez (**Evidence 2.12**). Camera trap spatial models and distance sampling analysis ongoing (Y2Q4-Y3Q1). Chimpanzee, baboon, Campbell's monkey and green monkey spatial models show distinctive distribution patterns of chimpanzees as compared to other primates, indicating distinctive spatial niches and anthropogenic effects within agro-forest landscape mosaics (**Evidence 3.1**). We confirmed the occurrence of African golden cat (*Caracal aurata*), an extremely elusive species, and other rare taxa in Cantanhez NP using camera traps.

- Health monitoring in Cantanhez NP has been developed further. We have fully integrated a UoE PhD project on genetics and leprosy occurrence (PhD candidate Marina Ramon, Main supervisor is PL) into the Darwin project. Targeted leprosy monitoring in chimpanzees with additional camera traps and intensive faecal sampling will commence in Y3Q1. Targeted leprosy monitoring will involve an additional 60 camera traps and 1200 faecal samples spread across three chimpanzee communities where leprosy is present (**Evidence 2.3 and 2.4**). Material was shipped to Bissau in Y2Q4 and training with DPOs is ongoing. The aim of this research is to quantify disease prevalence and transmission dynamics in three chimpanzee communities using DNA profiling and leprosy identification. Targeted camera traps will be used to monitor disease progression and gather data on social networks amongst individuals. This research will increase the number of people trained for health monitoring data collection (including 2 IBAP DPOs, 8 DFOs, 2 RCs, at 6 collaborators).

- Evaluation is ongoing using season 1 BMP data (**Indicator 2.3/Revised Indicator 2.4**). The BMP protocol was written up in October 2019 (Y1Q3) and revised in March 2020 (Y1Q4) upon completion of establishment and mapping of survey locations (camera traps and transects). The protocol is under third revision based on season 1 report by IBAP DPOs and data analysis (ongoing by UoE). Transect data collection methods by the DFOs – specifically, Cybertracker vs. GPS and datasheets – are under evaluation (via comparison, consultation with IBAP and analysis). This was discussed during our

M&E meeting in Y2Q4 with IBAP and we are currently evaluating the methods to ensure that the protocol will be applicable to other Protected Areas across the country upon completion of this project. Distance sampling analyses to obtain density estimates of chimpanzees, king colobus, Temminck's red colobus and Campbell's monkey are underway by two MSc students at UoE. These analyses will contribute to the evaluation of the BMP, specifically by assessing (1) the appropriateness of the sampling design, including number of transect repetitions, and (2) the suitability of a frequentist distance sampling analysis – the most commonly used analytical approach for abundance estimation – to obtain reliable population density estimates of primates in Cantanhez NP. The distance sampling analyses of transect data will be compared to point process-based spatial models by UoE DRF. Ongoing camera trap data analyses of primates and ungulates by UoE DRF using Bayesian-INLA (**Evidence 3.1**) will be used to evaluate the effectiveness of the current camera trap sampling design (including number of camera traps, placement, survey period length) to (1) identify key factors influencing wildlife presence and intensity of space use and (2) generate output maps to inform management in Cantanhez NP.

## Progress towards Output 3 Human-wildlife interaction plan

**Original Output 3. A human-wildlife interaction plan that extends protection of key wildlife habitat, and incorporates new regulations in areas of high human-wildlife interactions, including leprosy transmission risk, is developed for Cantanhez NP**

**Indicator 3.1** By end of Y2, key wildlife habitat including corridors, and areas of high risk of leprosy transmission are identified using monitoring data and faecal analysis.

**Indicator 3.2** By the end of Y3, the plan is developed by stakeholders (IBAP, Management Committee and other group representatives including from the Cantanhez Women's Associations) comprising at least 50% women.

**Indicator 3.3** By the beginning of Y4, the plan is written by IBAP and formally agreed by IBAP and local communities.

**Revised Output 3. A One Health environmental management plan to promote healthy human-wildlife coexistence and strengthen multi-stakeholder decision-making capacity in Cantanhez NP.**

**Revised Indicator 3.1** By the middle of Y3, key wildlife habitat including corridors, and areas of high human-wildlife interaction and potential disease transmission are identified.

**Revised Indicator 3.2** By the end of Y3, the plan is developed with stakeholders (Management Committee and other group representatives including from the Cantanhez Women's Associations) comprising at least 50% women.

**Revised Indicator 3.3** By the beginning of Y4, the plan is written up by project partners and agreed by IBAP and local communities.

- Spatial modelling of the BMP camera trap data to identify key wildlife habitat including corridors (**Indicator 3.1/Revised Indicator 3.1**) is ongoing (**Evidence 3.1**). Species considered in single-species spatial models are **six primates** including western chimpanzee, Guinea baboon, green monkey, Campbell's monkey, king colobus and Temminck's red colobus, and **five ungulates**, including bushbuck, Maxwell's duiker, black duiker, red river hog and buffalo. The occurrence of **rare species**, including elephant, giant pangolin, yellow backed duiker, red-flanked duiker, and African golden

cat (which was confirmed for the first time in Cantanhez with Y2 data), are included in species richness-based models and also mapped separately.

- Hotspot areas of potential disease transmission risks will constitute areas of high spatial overlap between humans and primates. For disease transmission risks we consider the occurrence of leprosy in chimpanzees and baboons, and consider the possible human-primate transmission of other known zoonotic diseases (e.g. Covid-19, common cold, scabies) according to disease characteristics and shared space and resource use. Y3 interview data will also be used to map finer scale locations of high human-wildlife interaction within the identified hotspots (e.g. shared water sources, specific orchards or sections of road).
- The development of the plan (**Indicator 3.2/Revised Indicator 3.2**) was discussed during our M&E meeting in March 2021 and IBAP highlighted the importance of the plan to inform future initiatives and activities in Cantanhez NP. Spatial model maps will be shared with IBAP in Y3Q1-2. Meetings will be carried out in Y3 (**Revised Activity 3.4**) with local stakeholders (incl. Women's and Youth's Associations, local health workers). Maps will be discussed with local people to identify aspects of human-wildlife interactions related to One Health to take into consideration, such as sites where resources are shared (water points, cultivated foods). The development of the plan is scheduled via a multi-stakeholder workshop in Y3Q3, which will include asking participants to propose measures to minimise pathogen transmission.

## Progress towards Output 4 Multi-stakeholder leprosy response plan

**Original Output 4. Increased long-term readiness for potential public zoonotic threats and disease-related conflicts through the initiation of an outbreak preparedness and response strategy in Cantanhez NP.**

**Indicator 4.1** By beginning of Y4, improved coordination, communication and collaboration amongst health and conservation stakeholders compared to baseline (zero)

**Indicator 4.2** By beginning of Y3, infectious zoonotic disease response strategy drafted and sources of financial aid to cover human medical treatment identified (e.g. Ministry of Health Guinea- Bissau, WHO)

**Indicator 4.3** By beginning of Y3, a response strategy in the event of retaliatory killings of protected wildlife developed and agreed by IBAP and community representatives.

**Revised Output 4. Increased long-term readiness for potential public zoonotic threats and disease-related conflicts through the development of a multi-stakeholder leprosy response plan for Cantanhez NP.**

**Revised indicator 4.1** By Y2, key health organisation focal points are identified. By the beginning of Y3, regular communication and collaboration between health and conservation organisations is established.

**Revised indicator 4.2** By the middle of Y3, multi-stakeholder knowledge of leprosy occurrence in humans and wildlife is improved via up-to-date case mapping.

**Revised indicator 4.3** By Y4, institutional knowledge to manage and respond to conflicts over leprosy disease (including mistrust of health services, retaliatory behaviour towards animals) and leprosy in humans is increased via the production of the first multi-stakeholder leprosy response plan in Guinea-Bissau.

- Progress towards establishing coordination, communication and collaboration amongst conservation and health stakeholders (**Indicator 4.1**/**Revised Indicator 4.1**) was achieved via various meetings in Y2Q4 (**Evidence 4.2**). In March 2021 project partners met with Dr Coelho (Cumura Hospital), four representatives of AIFO, and Mireille da Rosa Fernandes Pereira (WHO consultant) to initiate collaboration with key health stakeholders. UoE presented our leprosy research findings so far, as well as the Darwin project (Outputs, key activities). Stakeholders agreed to maintain regular communication over email to inform on project activities and exchange up-to-date information and knowledge.
- Progress towards improving multi-stakeholder knowledge of leprosy occurrence (**Revised Indicator 4.2**) has been made in Y2Q4 during the annual M&E meeting (23rd March 2021) and meetings with health organisations (AIFO, Cumura, WHO), sharing information on leprosy in chimpanzees in Cantanhez NP, including strain of *M. leprae* and possible origin of infection (**Evidence 4.3**). Up-to-date case mapping of leprosy cases across Guinea-Bissau will be conducted in Y3 based on case records at AIFO/Cumura Hospital.
- An additional component was included in the response plan. In Y3 RKI and UoE will work with IBAP and NADEL to develop and implement a protocol for the handling and management of dead chimpanzees (e.g. carcasses found in the forest, or due to retaliatory killings) to prevent disease transmission and increase scientific knowledge on disease present in chimpanzees in Cantanhez. This will involve training an IBAP team in use of PPE, carcass swabbing, data collection, sample handling and management, as well as a communication chain from local residents to community guards, IBAP and UoE when a carcass is identified (including what to do when encountering a dead animal, who to contact etc). Training in carcass swabbing is scheduled for Y3Q3 (part of **Output 2 – Revised Indicator 2.3**).
- An increase in multi-stakeholder knowledge to respond to conservation conflicts over disease and leprosy occurrence in humans in Cantanhez NP (**Revised Indicator 4.3**) will be achieved through multi-stakeholder collaboration in developing a health and conservation plan for Cantanhez NP. The plan is scheduled to be drafted in Y3Q3 by project partners based on literature information, knowledge exchange between project partners (including considering the socio-political context in Cantanhez NP and the revision and development of a communication chain from local to national level (Cumura Hospital) and WHO. The response strategy will be finalised in Y3Q4. Financial cover for the treatment of leprosy is provided by WHO (confirmed by WHO consultant and Cumura).

## 3.3 Progress towards the project Outcome

**Although these are yet to be formally approved by Darwin, we have included the revised activities (highlighted as Revised Outcome and Outcome Indicators in blue text) and actions taken in response to MTR evaluation in Section 10.**

**Original Outcome Reduced risk of transmission of leprosy benefitting 28,000 people and threatened wildlife through behavioural change in public health, mitigated conflicts over conservation and disease, and improved protection of key habitat**

**Indicator 0.1** By the beginning of Y4, capacity of the local health force to rapidly identify cases of zoonotic infections including leprosy is increased by 80% (n=8 health centres), and at least 25 of 50 households surveyed demonstrate improvement in health-related behaviours compared to baseline established in Y1

**Indicator 0.2** By the beginning of Y3, multi- stakeholder preparedness for leprosy outbreak and related conflicts is increased through the involvement of stakeholders (n=5 groups), compared to baseline zero.

**Indicator 0.3** By the beginning of Y4, wildlife associated with 12 protected forest blocks (c. at least 70km$^2$ across CNP) are surveyed for abundance and leprosy (primates). No decrease in primate abundance compared to baseline established in Y2.

**Indicator 0.4** By the end of Y3, there has been no loss of key habitat (in protected forest blocks) from baseline established in Y1.

**Revised Outcome Improved knowledge and surveillance of leprosy in wildlife and humans, with enhanced capacity to manage human-wildlife interactions and support conservation and human health at Cantanhez NP.**

**Revised Indicator 0.1** By end of project, leprosy in humans and nonhuman primates is integrated into One Health strategies, and an evidence-based One Health campaign strategy is developed for Cantanhez NP.

**Revised Indicator 0.2** By end of project, institutional capacity to monitor disease in wildlife in Cantanhez NP is increased to 80% compared to baseline (zero) through the implementation of biodiversity monitoring and the establishment of an IBAP surveillance team for sample collection and management of animal carcasses.

**Revised Indicator 0.3** By end of project, human-wildlife interactions related to One Health risks are incorporated into management strategies for Cantanhez NP, and at least 30% of IBAP's technical team have attended training in monitoring forest changes in protected forest blocks using remote sensing and GIS.

**Revised Indicator 0.4** By end of project, improved coordination between health and conservation stakeholders have enhanced institutional capacity to respond to zoonotic disease and disease-related conservation conflicts.

- Progress towards integrating leprosy with One Health strategies (**Revised Indicator 0.1**) was made in Y2 through the start of a collaboration with Guinean health authorities and an NGO focal point, responsible for combating leprosy in Guinea-Bissau. Project partners, WHO consultant Mireille da Rosa Fernandes Pereira and AIFO representatives have agreed that One Health is a pertinent approach to the leprosy context in Cantanhez NP, considering the presence of leprosy in nonhuman primates and humans, with the possibility of a yet to be identified animal or environmental reservoir. Project partners and health stakeholders have agreed to collaborate and meet regularly.
- Wildlife surveys across Cantanhez NP (**Indicator 0.3/Revised Indicator 0.2**) began in November 2019 with the selection of transects and camera trap locations (Y1Q3) and data collection (Y1Q4) and is running better than expected. The biodiversity monitoring programme is a long-term commitment; the reason it kept running during the Covid-19 pandemic is because IBAP recognised the importance of monitoring biodiversity and human activities, with the benefits outweighing the pandemic challenges. A survey area of 540 km$^2$, associated with 13 forest blocks has been fully implemented (**Evidence 2.9, 2.10, 2.11**). In addition to the continued monitoring of leprosy progression in individuals from three chimpanzee communities, we identified three new chimpanzee individuals showing advanced clinical manifestations of leprosy from two additional chimpanzee communities across the northern part of the park ("Faro Sadjuma" and "Quartel Guiledje", **Evidence 2.12**). Carcass swabbing training is scheduled for Y3. A surveillance team responsible for sampling and safely disposing carcasses of wild

animals will contribute to enhancing capacity for disease screening in wildlife through analysis of organ and bone material.

- Some progress towards integrating human-wildlife interactions in conservation management (**Revised Indicator 0.3**) has been achieved through data analysis and project partners meetings in Y2Q3-4. Biodiversity monitoring (BMP) data analyses are ongoing (began Y2Q3). Environmental and anthropogenic factors affecting wildlife distribution have been identified for four primates so far (**Evidence 3.1**). These data, along with participatory mapping (scheduled for Y3), will provide up-to-date information on human-wildlife interaction patterns to inform management plans for Cantanhez NP.
- Some progress towards increasing multi-stakeholder capacity to integrate human and wildlife dimensions into a strategic plan to reduce leprosy in humans and disease-related conservation conflicts (**Revised Indicator 0.4**) was made via the collaboration with key health organisations involved in leprosy work in Guinea-Bissau initiated in Y2Q4. Participants included three representatives from AIFO, one from Cumura Hospital, one from the WHO, as well as project partners NADEL, IBAP, CRIA and UoE.

## 3.4 Monitoring of assumptions

To stop the spread of COVID-19, on the 17th March 2020, authorities in Guinea-Bissau announced the closure of land borders, and on the 18th March 2020 announced a ban on all flights landing at Osvaldo Viera International Airport. The Government of Guinea-Bissau announced a state of emergency, enforcing the closure of schools, markets, and cessation of concerts, shows, and religious and traditional ceremonies until the 31st March 2020. Authorities in Guinea-Bissau have extended the country's state of emergency to at least the 24th May 2021. All restrictions are subject to amendment at short notice. These, along with measures taken globally including by the United Kingdom in response to the COVID-19 pandemic, have prevented us from conducting our activities as described in the original proposal (e.g. in-person meetings, interviews etc). However, we have adapted our approach to be able to continue with progress towards our Outcome and Outputs (see Sections 3.1, 3.2 and 3.3). For this, a new assumption is required: *The COVID-19 pandemic does not worsen to such levels in the United Kingdom and Guinea-Bissau that we cannot continue with any of our revised activities.*

The Ebola and Covid-19 situations are evolving, and we will need to take this into account in our strategy (One Health approach, zoonotic risks, conflict mitigation). There is community transmission of COVID-19 but the newly reported cases are very low, with only 14 new cases detected in the last week (19-25 April 2021), and a steady decrease in the number of cases over the last six weeks. No active cases of COVID-19 have been reported in the Tombali region in the last week, where the research will take place [data released and regularly updated by the Guinea-Bissau government: https://accovid.com]. By the 28th April 2021, Guinea-Bissau had suffered a total of 3,731 cases and 67 deaths. A campaign is currently underway to administer COVID-19 vaccines across the country. At present, the Ebola outbreak in neighbouring Guinea remains concentrated in Nzérékore (southeast Guinea). However, high alert is maintained in neighbouring countries including Guinea-Bissau, where a possible case was investigated in Cacine in April 2021 (now confirmed negative).

### OUTCOME ASSUMPTIONS

**Assumption 1** *Anonymous data shared for all patients and records kept appropriately by health workers (health data was previously shared during cholera outbreak with NADEL). Training of health workers in file management and confidentiality.*

Comments: Cumura Hospital and AIFO have agreed to share patient records.

**Assumption 2** *Stakeholders, including partners and key local collaborators such as the Womens Association, remain engaged and committed to improve public health throughout the project.*

Comments: Commitment by project partners has been demonstrated through the engagement of health stakeholders in Y2Q4 (**Evidence 4.2**). In addition, Guinean partners NADEL and IBAP, as well as health stakeholders WHO and Dr Silvio Coelho at Cumura Hospital are currently strongly engaged with improving public health in light of the COVID-19 pandemic and Ebola surveillance and preparedness strategies. The COVID-19 pandemic has prevented UoE from direct engagement with local communities, including the Women's Associations, in Y2, although some communication has been maintained through WhatsApp. However, project partners IBAP and NADEL have worked directly with local communities to respond to the pandemic, including working with local chiefs, management committees, health centres and Associations (incl. Associação de Jovens Estudantes de Cubucaré – AJEC) to distribute cleaning material and deliver information about COVID-19 across Cantanhez NP (**Evidence 4.4 and 4.5**).

**Assumption 3** *Local community leaders and IBAP remain committed to developing an evidence-based conservation strategy to reduce the risk of potential leprosy transmission, including protection of key wildlife habitat and monitoring of high- risk areas.*

Comments: Community engagement remains a top priority in our project. This assumption will be crucial in Y3. We however revised the wording to accommodate changes in the logframe.

**Revised Assumption:** *Stakeholders, including partners and key local collaborators such as the Women's Associations, remain engaged in project activities, including developing health and conservation strategic plans.*

**Assumption 4** *Country remains politically stable (since its inception IBAP has remained unaffected by political instability and our research team has experienced no problems working in Cantanhez NP).*

Comments: Despite presidential elections on the 24th November and the 27th December 2020, and the following political crisis due to contested elections and the forced removal of some of the government's ministers including the Prime Minister, we were able to continue our research activities.

**OUTPUT 1 ASSUMPTIONS**

**Assumption 5** *Health DFO's remain active and engaging throughout the campaign, and the local communities are willing to dedicate time and engage in activities throughout the duration of this project.*

Comments: Assumption for Y3. To accommodate changes in the logframe, this assumption was revised.

**Revised Assumption:** *Local communities are willing to dedicate time and engage in activities throughout the duration of this project.*

**Assumption 6** *Risks of leprosy-related retaliatory behaviour towards wildlife are reduced by increasing the public's knowledge about zoonotic disease (including information about transmission risks, mitigation strategies associated with human behaviour, leprosy disease life cycle, health care provision by the local and regional health institutions).*

Comments: Assumption for Y3. Project partners and health stakeholders (Cumura, AIFO) have agreed to mitigate risks of possible retaliatory behaviour towards wildlife by ensuring that messages about the presence of leprosy disease in wildlife are delivered in a sensitive manner, including alongside One Health messages, information about mitigation measures to reduce risks of cross-species transmission (including strongly avoiding to touch or handle dead and sick wildlife, keep wild animals as pets, etc) and information about the risks of contracting leprosy (higher human-to-human transmission risks compared to extremely low risks of animal-to-human transmission if mitigation measures are followed.

**Assumption 7** *The presence of leprosy in chimpanzees at Cantanhez is not discussed with and sensationalised by the media (to avoid this, we have a signed confidentiality agreement between IBAP, NADEL and researchers).*

Comments: In February 2020 project partners discussed and agreed to the development of a communication approach that takes into account the sensitivity of the presence of leprosy in chimpanzees in Cantanhez NP. This was discussed with and agreed by the Health Minister. In order to avoid sensationalism by the media, she suggested a collaboration with the National Institute for Public Health (INASA), the national authority responsible for public health-related communications. It was decided that communications about leprosy would be included in a communication about zoonotic diseases in general, and this One Health communication would include information on the existence of leprosy in chimpanzees. These points were discussed again during meetings with WHO, Cumura Hospital and AIFO in Y2Q4. Representatives agreed to the need to avoid miscommunication through the media and will work with our project team to find appropriate ways to communicate information about leprosy in chimpanzees to the public.

## OUTPUT 2 ASSUMPTIONS

**Assumption 8** *Partner organisation staff (IBAP) continue to be employed during and beyond the completion of this project (and find substitutes if necessary).*

Comments: The employment of park staff (including the eight DFOs) remains key to ensure that activities continue to be carried out to achieve progress towards the Outcome and Outputs 2-4.

## OUTPUT 3 ASSUMPTIONS

**Assumption 9** *Partners and local stakeholders remain committed to engage in project meetings and workshop.*

Comments: This remains a critical assumption to ensure the effectiveness of Output 3. Project partners have agreed to meet regularly in Y3 to discuss the progress towards Output 3. Meetings with local stakeholders are scheduled for Y3.

**Assumption 10** *Consensus is achieved for the plan.*

Comments: Scheduled for Y3Q4-Y4Q1. Consensus will be required amongst partner organisations and local stakeholders. This remains a key assumption to ensure the realisation of the One Health environmental management plan.

**Assumption 11** *No unresolvable conflict occurs between local communities and partners during the course of this project.*

Comments: This remains a critical assumption. Formal and informal discussions with project partners, local stakeholder representatives and local collaborators will continue to be carried out throughout the project to ensure that any potential disagreement can be addressed promptly (before it evolves into conflict), adequately (if necessary, involving external professional mediators) and in a culturally and socio-politically sensitive manner (all partner organisations working directly with local stakeholders have extensive experience in working in Cantanhez). In Y2Q3 biodiversity monitoring could not be carried out in the jurisdiction of a village chief who expressed and organised resistance to permitting any data collection in their forest. Issues were resolved in Y2Q4 following meetings between IBAP and the local chief and residents of the communities involved.

## OUTPUT 4 ASSUMPTIONS

**Assumption 12** *Stakeholders recognise the long-term importance of the strategy and remain committed throughout and beyond the completion of this project.*

Comments: This remains a critical assumption (Y3-Y4). The development of a multi-stakeholder leprosy response plan for Cantanhez NP requires input and endorsement from multiple Institutions.

**Assumption 13** *Roles and responsibilities in mitigation strategies and response to emergencies are fully accepted and recognised by partners and stakeholders.*

Comments: This remains a critical assumption (Y3-onwards). Institutions agree on their roles as documented in the leprosy response plan. We will continue to work with partners and Institutional stakeholders to ensure that this assumption will be satisfied.

**Assumption 14** *Response team and stakeholders take responsibility to find substitutes if necessary.*

Comments: As the strategy will not be implemented during this project, this assumption only applies to the agreement of Institutional roles and responsibilities in the response plan.

## 3.5 Impact: achievement of positive impact on biodiversity and poverty alleviation

This project aims to improve public health through increased resilience to infectious disease in local communities, with improved capacity to manage threatened biodiversity and human-wildlife interactions, at Cantanhez National Park. This in turn will result in more resilient, safer, stronger communities. Our framework is based on the One Health concept which describes how human health is inextricably linked to the health of animals and the viability of ecosystems. One Health is at the forefront of issues related to emerging infectious disease and disease dynamics, specifically associated with increased interaction between humans and wildlife (such as human encroachment on wild habitats, and the trade in wild animals and wild animal parts). Its approach involves the collaboration of human, animal, and environmental researchers and health professionals and is geared towards optimising individual and community health and wellness. This initiative reflects a growing concern that rapid and irreversible rates of environmental degradation will harm human health and well-being in ways that cannot be undone or ‘cured’ by medical treatments.

Positive impacts on poverty alleviation are expected through increased resilience to infectious disease outbreaks, at a community and Institutional level. Beyond building collaborative relationships and local capacity building, it is too early to claim potential project impacts, and these will be determined in Y3/Y4. We are obtaining research data on leprosy occurrence in wildlife, including identifying species infected, prevalence and patterns of occurrence of leprosy disease in chimpanzees, as well as leprosy strain sequencing. We are collaborating with Cumura to ensure that the local health force, including local health agents and traditional healers, can rapidly and effectively identify leprosy in people in Cantanhez NP from early stages and make appropriate patient referrals, with predicted positive impacts on human wellbeing and poverty alleviation. The development of a leprosy response plan will ensure information dissemination and effective communication chains between multiple stakeholders. Our project framework aligns with the WHO Global Leprosy Strategies' (2016–2020 and 2021–2030) vision, pillars and components, including to reduce transmission of leprosy infection, strengthen coordination and partnerships, strengthen surveillance, facilitate research on all aspects of leprosy and maximise the evidence base to inform policies, strategies and activities, effective surveillance and data management systems (2014–2020: https://apps.who.int/iris/handle/10665/208824; 2021–2030: https://apps.who.int/iris/handle/10665/340774).

Positive impacts on biodiversity are expected through increased monitoring of abundance and health of wildlife as well as human activities, and increased local engagement and decision-making via the One Health environmental management plan which will build upon the existing Cantanhez Management Plan which does not take account of human-wildlife interactions including disease. The leprosy response plan integrates strategy to avoid retaliatory killings of wildlife. We have worked with project partners to adapt the project to take account of COVID-19 and (the threat of) Ebola in the region, and integrate this into our current Darwin work. The

transects which are part of the biodiversity monitoring component of the project are aimed at measuring animal densities and abundance and importantly will allow us to patrol terrestrial locations for human activities including hunting and logging. The presence of the DFOs in the forest (which have followed strict protocols to mitigate against potential spread of coronavirus to wildlife) has the benefit of discouraging illegal activities such as hunting and forest clearing. Aside from direct negative consequences such as biodiversity loss, hunting and forest clearing have the potential to increase the risk of disease spillovers into wild primates due to increased contact.

The WHO Global Leprosy Strategy 2021–2030 (https://apps.who.int/iris/handle/10665/340774) will advance progress on the WHO Roadmap for Neglected Tropical Diseases 2021–2030 and the Sustainable Development Goal targets. Our project tackles many of the major challenges outlined in this document (see page 11) including cutting-edge research on wildlife and human dimensions of leprosy; reducing delays in detection; strengthening capacity and leprosy expertise; ensuring meaningful engagement of relevant stakeholders; reducing stigma in healthcare settings through knowledge and training; developing a communication and surveillance system; providing suggestions for information systems to report leprosy cases. In particular the strategy states that "Zoonotic transmission of *M. leprae* by the nine-banded armadillo *(Dasypus novemcinctus)* has been demonstrated[20] but until now the risk appears low and highly localized. There is no evidence of transmission from other known animal reservoirs." Our research provides up-to-date information on leprosy in human's closest living relative, the chimpanzee, as well as other primates, in the wild. This is the first evidence in Africa of leprosy outside of humans and will provide key information on zoonotic disease transmission.

## 4. Contribution to the Global Goals for Sustainable Development (SDGs)

It is too early to claim that we have contributed to all SDGs proposed in our project, although we have made some progress. We have included women at all stages of the decision-making process (Goals 5,10), including project partners at IBAP, UoE, CRIA, and RKI, and we have employed a young Guinean woman, Maimuna Jalo, as DPO. We met with the female Minister of Health in Guinea-Bissau Magda Robalo (2019) and started collaboration with WHO's consultant in Guinea-Bissau Mireille Pereira (2021). We have worked directly with the Women's Associations, the local management committee and the Association of Young Students of Cubucaré (AJEC) in Cantanhez NP. We have collected data to better understand local knowledge/perceptions of disease transmission and healthcare services to inform public health strategy (that will work towards achieving Goals 1,3,5,6), and we are responding to the current COVID-19 pandemic to ensure contributions to wildlife and human health.

From the outset we have ensured participatory community involvement in public health issues to reduce gender inequality, and strengthen synergy in stakeholder (local communities, Government, NGO) decision-making (Goals 5,10,17), and this will be an ongoing process.

We are on course to deliver the following SDGs over the duration of the project:

- Building local people's awareness/resilience to infectious disease outbreaks, including leprosy, through improved understanding of One Health, and access to specialised healthcare services, and strengthening the communication of leprosy cases and surveillance system (Goals 1,3).
- Working with healthcare practitioners to increase the number of skilled leprosy staff and reduce potential stigmatization associated with leprosy which prevents self-reporting/early diagnosis (Goals 1,3,5,6).
- Improved access to hygiene for all for leprosy, paying close attention to the needs of women and girls, and strengthen the participation of local communities in improving sanitation management through One Health (Goal 6).
- Directly integrating ecosystem and biodiversity values into National and local leprosy planning and implementing targeted capacity building of stakeholders in health and conservation (Goal 17).

- Ensuring the conservation of forests and reducing the loss of threatened biodiversity (Goal 15), including the western chimpanzee.
- Developing a multi-stakeholder leprosy response plan for Cantanhez NP to support long-term investment in leprosy eradication actions (Goal 1), in particular the WHO's Global Leprosy Strategy 2021–2030, and contributing critical data on leprosy in wildlife reservoirs to work towards SDG's Goal 3 to end epidemics of neglected tropical diseases including leprosy.
- Working towards making communities safe, resilient and sustainable (Goal 11) supporting the Lancet Commission's call for a new Planetary Health paradigm which sets out to achieve the highest attainable standard of health, wellbeing, and equity worldwide through judicious attention to the human systems—political, economic, and social—that shape the future of humanity and the Earth's natural systems that define the safe environmental limits within which humanity can flourish.

## 5. Project support to the Conventions, Treaties or Agreements

The work undertaken in this project is intended to help Guinea-Bissau meet obligations under CBD's core principles for the programme of Work on Forest Biodiversity and in particular CBD Aichi Biodiversity Targets. Dr. Abilio Rachid Said and Dr. Justino Biai are both named as IBAP project partners and CBS focal points in Guinea-Bissau. Both have attended all Darwin workshops and meetings, and the PI is in regular email contact with both.

Our project will contribute through:

1. Increasing local biodiversity and wildlife health monitoring capacity in the most biodiverse terrestrial NP in Guinea-Bissau and increasing knowledge of leprosy and other infectious diseases in wildlife (Targets 2,19) (**Evidence 2.9, 2.11, 2.12, 2.13 and 3.1**) (**Revised Indicators 0.2**, **2.1**, **2.2**, **2.3**, **2.4**). Our approach will be used as a model for Guinea-Bissau's four other terrestrial NPs.
2. Conducting long-term monitoring of biodiversity health and abundance (Target 12) to identify and improve protection of remaining forests, including mangroves, and wildlife hotspots to promote biodiversity and protection of ecosystems that provide essential services (Targets 5,11,14) (**Evidence 2.9, 2.11, 2.12, 2.13 and 3.1**) (**Revised Indicators 0.2**, **2.1**, **2.2**, **2.3**, **2.4**, **3.1**).
3. Monitoring leprosy prevalence and distribution in primates and reducing opportunities for human-to-wildlife/wildlife-to-human disease transmission through research-led mapping (Targets 2,12) (**Evidence 2.3, 2.12 and 2.13**) (**Revised Indicators 0.2**, **2.1**, **2.2**, **2.3**, **2.4**, **3.1**, **3.2**, **3.3**).
4. Increasing the resilience of communities by adopting an ecosystem-mediated strategy for health promotion based on One Health - reducing environmental damage which may be having a detrimental impact on human health, especially vulnerable sub-populations such as the poor, socially disenfranchised, children and the elderly (Targets 3, 14) (**Revised Indicators 0.1**, **0.3**, **0.4**, **1.2**, **1.3**, **3.2**, **3.3**, **4.3**).
5. Respecting traditional knowledge and management systems (Target 18). Since Cantanhez NP was formed in 2008 the local population continues to play a role in land use management. People represented by chieftains, Women's Associations, Land Management Committee, Youth Associations and elders will play a crucial role in developing a plan to improve biodiversity conservation and reduce disease transmission risks in Cantanhez NP (Target 18) (**Revised Indicators 1.1**, **3.2**, **3.3**).
6. Understanding local knowledge and perceptions of disease transmission and local healthcare services (traditional and public) to inform public health strategy (Targets 18,19) (**Evidence 1.1 and 1.2**) (**Revised Indicator 1.1**).
7. Ensuring participatory community involvement in public health issues to reduce gender inequality, and strengthen synergy between local communities, NGOs, and Government in decision-making (Target 18) (**Revised Indicators 0.1**, **0.3**, **1.2**, **1.3**, **3.2**, **3.3**).
8. Strengthening capacity and knowledge to respond quickly and effectively to infectious disease outbreak (Target 19) (**Evidence 4.2**) (**Revised Indicators 0.1**, **0.4**, **4.2**, **4.3**).

9. Strengthening long-term readiness for potential public zoonotic threats and disease-related conflicts through the development of a multi-stakeholder leprosy response plan for Cantanhez NP that includes mitigation of conservation conflicts and disease risk. The plan identifies potential long-term sources of financial aid to cover human medical treatment (Target 17) (**Revised Indicators 0.4**, **4.2**, **4.3**).
10. Making datasets on leprosy available to interested parties e.g. for the WHOs Global Leprosy Strategy 2021–2030 (Target 19) (**Evidence 4.3**) (**Revised Indicators 0.4**, **4.3**).

## 6. Project support to poverty alleviation

Positive impacts on poverty alleviation are expected in the long-term through increased knowledge of One Health and resilience to infectious disease outbreaks as outlined in the previous sections. The beneficiaries include:

- Residents of partner villages who will participate in the One Health trial campaign, including at least 50% women. Impacts to at least 60 participants will include (i) increased capacity to empower their community with knowledge on One Health, and (ii) increased decision-making capacity in One Health strategies.
- IBAP DFOs involved in this project are expected to benefit in the long-term through enhanced professional skills as a direct result of this project.
- Six local collaborators employed in leprosy monitoring of rural communities in Cantanhez NP. Positive impacts include (i) increased household income via monthly salary, and (ii) increased professional skills.
- Health agents and traditional healers (at least 60 people). Impacts are expected via increased professional knowledge and capacity to identify leprosy cases, including at the early stages, and make appropriate referral.
- Local IBAP collaborators across Cantanhez NP. Impacts are expected via increased awareness of zoonotic disease transmission and increased professional capacity to report carcasses of wild animals found in the forest and dead chimpanzees from retaliatory killings in cultivated areas.
- The local population in Cantanhez NP is expected to benefit from evidence-based multi-stakeholder policies to improve environmental and human wellbeing in Cantanhez NP, including the One Health environmental management plan and the multi-stakeholder leprosy response plan.

## 7. Consideration of gender equality issues

We are doing everything we can to ensure females are fully represented in this project. This was commented on positively by Guinea-Bissau's female Health Minister during our meeting and also by Aissa Regalla, IBAP project partner. We are collaborating with WHO consultant for Guinea-Bissau, Mireille da Rosa Fernandes Pereira. We are working directly with the Women's Associations in Cantanhez NP to ensure the opinions and needs of women and girls are fully represented throughout the project, from initial consultation and final evaluation. Using qualitative data collection, we are working with women to identify perceptions of disease and health services, as well as women-specific healthcare needs. For exploratory questionnaires, out of 31 persons interviewed, 15 were female. Although most healers and health centre professionals are male, we interviewed one female healer and one female nurse. We will ensure that all meetings and workshops are held at times when female representatives are able to participate. For social reasons, local women are sometimes reluctant to share their opinions during large meetings and

workshops. To avoid this, we are holding additional focus group meetings with women to ensure their opinions are incorporated into our conservation and health strategies.

This project is supporting and working closely with Aissa Regalla at IBAP, who is a strong female advocate for the inclusion of local women in biodiversity conservation in Guinea-Bissau. She identified and encouraged women to apply for the Darwin Project Officer position at IBAP resulting in a young radiate and highly talented female graduate, Maimuna Jalo, to be employed. The importance of women in disseminating and campaigning for health-related improvements is well known to all project partners including NADEL. We are discussing employment/volunteers directly with the Women's and Youth's Associations to ensure that local women in Cantanhez NP have equal opportunity to employment as Health DFOs.

One of the six local collaborators (Fatumata Nbalo Camará, resident of Camecote) employed in leprosy monitoring is the first female resident of Cantanhez NP to be employed in ecological research (**Evidence 2.4**). Local employment is often undertaken with the help of village chiefs and committees, to follow local customs and to avoid conflicts amongst village residents regarding who should have been selected for the job. We expect that assumptions regarding gender in this type of work (typically undertaken by men) to change as a result of the increased employment of Guinean female researchers. An increase in female researchers, particularly Guinean women, is also likely to encourage more local women to consider employment and career opportunities in conservation.

The research article 'leprosy in chimpanzees' which was generated using data collected during this project is currently undergoing revisions in *Nature*. The article includes eight African Nationals as co-authors including two females, one of whom is Aissa Regalla. High impact collaborative publications support academic development and foster productive dialogue and relationships.

## 8. Monitoring and evaluation

As reported throughout this report, monitoring and evaluation is an intrinsic component of this project and we are continually responding to new developments with our project partners, including making adjustments to the project in response to MTR feedback. We have committed to many M&E best practices, including SMART indicators; annual M&E meetings and workplans; meetings and reporting to all partners (including Y3/4 meetings every 2 months with all partners); activities to establish baselines and measure change; the revision of targets, activities and timelines in response to COVID-19 to ensure project success; the routine monitoring of key project activities; and half-year and annual reports.

## 9. Lessons learnt

- The COVID-19 pandemic has demonstrated the need for flexibility and preparedness in the case of most exceptional circumstances. We recommend that field supplies (e.g. batteries, SD cards) are taken to field sites as early as possible to ensure they are accessible by Guinean partners if travel between Europe and Africa is restricted.

- Y1 and Y2 have shown us that we need to organise the collection of social data in stages in order to better plan the survey with greater knowledge of how different user groups perceive diseases in Cantanhez. This allows time and resources not to be wasted on the development of an extensive survey which is not adequately designed. Questions for an extensive survey must be developed from the results of an exploratory survey.

## 10. Actions taken in response to previous reviews (if applicable)

In our revised logframe (**Annex 2.1**) we have fully considered all the points raised in the MTR review that are feasible to achieve within the available timeframe and budget. We have consulted our project partners and adapted the Outputs and logframe based on feasibility and time, and what we think is logical and most appropriate and useful considering our areas of expertise and collaborations within Guinea-Bissau. The most significant changes have been to Outputs One, Three and Four.

Revisions were made to Output One as a result of the COVID-19 and Ebola situations, COVID-19 delays and in response to MTR comments. We originally planned to develop and implement a public health campaign across Cantanhez NP, involving at least 70 villages. Due to the COVID-19 and Ebola campaigns already underway across Guinea-Bissau, including Cantanhez NP (NADEL are involved in these), we made the decision to reduce the spatial scale of our campaign to selected villages, and adopt a One Health approach rather than focussing the campaign on a specific zoonotic disease. Instead our campaign will focus on One Health messages, with leprosy used as an example zoonotic disease. The reduction in scale was due to the complexities involved in delivering One Health concepts effectively and to trial messages in selected villages to avoid miscommunication, *particularly regarding the level of public health dangerousness of leprosy occurrence in wildlife for local people*. Our new One Health trial campaign approach allows us to explore and identify effective ways to deliver One Health messages, which will be incorporated into a One Health campaign strategy report for future application, including scaling-up to Park- and Regional-levels, by health and conservation institutions working in Guinea-Bissau. We have also scaled up the clinical training to involve local health agents and traditional healers and they were identified as being crucial to an effective response.

We revised Output Three and have incorporated the suggestion to adapt the proposed human-wildlife interaction plan to a One Health environmental management plan that promotes healthy human-wildlife coexistence and strengthens multi-stakeholder decision-making capacity in Cantanhez NP. In response to MTR comments we are including participatory mapping with local people from different user groups to identify sites with high human-wildlife interaction, including locations of resources shared. This will be conducted within the same villages where we will conduct the revised One Health trial Campaign.

COVID-19 delays have made the implementation of a disease and conflict response strategy unfeasible given the remaining time available as pointed out in the MTR evaluation. Output 4 has now been revised to focus on gathering up-to-date leprosy information to develop an evidence-based multi-stakeholder leprosy response plan to inform conservation and health institutions involved in work in Cantanhez NP, including all project partners, health stakeholders (including WHO, AIFO), and government (Ministry of Health, Forestry Department). This plan will comprise up-to-date information on leprosy occurrence in wildlife and humans, a literature review of conservation conflicts over disease, a literature review of existing disease outbreak response strategies in Guinea-Bissau, One-Health and WHO policies for leprosy, and current Institutional arrangements in Guinea-Bissau.

## 11. Other comments on progress not covered elsewhere

We have covered detailed information on our progress in other sections of this report.

## 12. Sustainability and legacy

This project that integrates biodiversity conservation and public health in response to leprosy is the first of its kind in Cantanhez NP. This has meant that project partners and other stakeholders including the local communities remain engaged and positive about the work. There is strong acknowledgement of the importance of a One Health approach to understanding and tackling infectious diseases outbreaks. Local communities' express similar viewpoints on One Health approaches. One Health is a worldwide strategy for expanding interdisciplinary collaborations and communications at the intersection of environmental conservation and public health. Understanding these linkages highlights the importance of interdisciplinary approaches to research which sets out to inform disease prevention, awareness campaigns and policy development.

By investing in capacity and engagement of local communities and project partners, including employed personnel, our goal is to strengthen the sustainability and legacy of the project. Our activities are designed to increase future resilience through training and capacity building so that in the potential absence of future funding our project partners and local collaborators have a strengthened knowledge base from which to build and continue key activities.

Our project tackles many of the major challenges outlined in the WHO Global Leprosy Strategy 2021–2030 (https://apps.who.int/iris/handle/10665/340774) including cutting-edge research on wildlife and human dimensions of leprosy; reducing delays in detection; strengthening capacity and leprosy expertise; ensuring meaningful engagement of relevant stakeholders; reducing stigma in healthcare settings through knowledge and training; developing a communication and surveillance system; providing suggestions for information systems to report leprosy cases. In particular the strategy states that "Zoonotic transmission of *M. leprae* by the nine-banded armadillo *(Dasypus novemcinctus)* has been demonstrated20 but until now the risk appears low and highly localized. There is no evidence of transmission from other known animal reservoirs." Our research provides up-to-date information on leprosy in human's closest living relative, the chimpanzee, as well as other primates, in the wild. This is the first evidence in Africa of leprosy outside of humans and will provide key information on zoonotic disease transmission and has generated a great deal of interest including in Science AAAS: (https://www.sciencemag.org/news/2020/11/leprosy-ancient-scourge-humans-found-assail-wild-chimpanzees).

## 13. Darwin identity

This project is recognised as a distinct project with a clear identity. As the first project to be funded by the Darwin Initiative in Guinea-Bissau, it is Nationally and locally known as "Projecto Darwin". All project documents include a Darwin Initiative logo, which has been used in National and International conference/meeting/workshop presentations (including **Evidence 2.11, 4.1, 4.3**).

## 14. Impact of COVID-19 on project delivery

An international travel ban was enforced by the Bissau-Guinean government in April 2021; in March 2020 IBAP already halted all research activities to mitigate the spread of COVID-19 to vulnerable communities in Protected Areas, including Cantanhez NP. To ensure health and safety of project staff undertaking biodiversity monitoring activities in Cantanhez NP, we developed and implemented a COVID-19 health protocol in Y2Q1 (**Evidence 2.1**). This allowed for the resumption of biodiversity monitoring activities by local staff (DFOs and RCs). Interviews and in person meetings with local communities originally planned to be carried out in Y2Q1-2

by NADEL DPO and UoE DRF had to be halted due to risks of spreading COVID-19 to residents in Cantanhez. This caused significant delays in activities related to Output 1 and Output 4, and forced us to revise our strategy several times, as well as incorporating the COVID-19 situation and context within our project framework, including changing to a One Health approach rather than focussing on specific diseases. For instance, a significant impact was on our public health campaign across 70 villages, which was planned to start in October 2020. Considering the COVID-19 national response and local campaigns ongoing throughout Y2, we opted instead to use a different campaign approach and delay the start until enough data were available to develop a strategy, including household interview data (**Evidence 1.2**), information on the COVID-19 response in Cantanhez NP (**Evidence 4.5**), as well as discussions with partners and health stakeholders (**Evidence 4.2**). Output 1 was revised also based on MTR comments (see **Section 10**). COVID-19 delays also made the implementation of a disease and conflict response strategy (original Output 4) unfeasible given the remaining time available. Output 4 has been revised to focus on gathering up-to-date leprosy data to develop an evidence-based multi-stakeholder leprosy response plan to inform conservation and health institutions involved in work in Cantanhez NP, including all project partners, health stakeholders and government (Ministry of Health, Forestry Department).

## 15. Safeguarding

Please tick this box if any safeguarding or human rights violations have occurred during this financial year. ☐

If you have ticked the box, please ensure these are reported to ODA.safeguarding@defra.gov.uk as indicated in the T&Cs.

We have no safeguarding concerns for the project. The University of Exeter has strict safeguarding policies in place that this project has strictly adhered to. Please see link for the University's safeguarding framework: http://www.exeter.ac.uk/media/universityofexeter/governanceandcompliance/docs/Safeguarding_Framework.pdf

All research has been reviewed by an ethics board to ensure the project work safeguards all informants and respondents.

## 16. Project expenditure

Please expand and complete Table 1. If all receipts have not yet been received, please provide indicative figures and clearly mark them as Draft. The Actual claim form will be taken as the final accounting for funds.

**Table 1: Project expenditure during the reporting period (1 April 2020 – 31 March 2021)**

| Project spend (indicative) since last annual report | 2020/21 Grant (£) | 2020/21 Total Darwin Costs (£) | Variance % | Comments (please explain significant variances) |
|---|---|---|---|---|
| Staff costs (see below) | [redacted] | | | |
| Consultancy costs | | | | |
| Overhead Costs | | | | |
| Travel and subsistence | | | | |

| | |
|---|---|
| Operating Costs | [redacted] |
| Capital items (see below) | |
| Monitoring & Evaluation (M&E) | |
| Others (see below) | |
| **TOTAL** | |

## Annex 1: Report of progress and achievements against Logical Framework for Financial Year 2020-2021

| Project summary | Measurable Indicators | Progress and Achievements April 2020 - March 2021 | Actions required/planned for next period |
|---|---|---|---|
| ***Impact***<br><br>Improved public health through increased resilience to infectious disease outbreaks in local communities, with improved capacity to manage threatened biodiversity and human-wildlife interactions, at Cantanhez National Park, Guinea-Bissau. | | The development of a One Health trial campaign is ongoing. Collaboration with health organisations (Cumura, AIFO, WHO) has started in Y2Q4. The BMP is up and running and first season survey data analysis to inform management of biodiversity and human-wildlife interaction has commenced (40% of analysis achieved by end of Y2). Increased resilience to disease outbreaks is expected via multi-stakeholder strategic plans and collaboration, engagement of local communities in One Health trial campaign. Improved capacity to manage threatened biodiversity is expected via the establishment of the first biodiversity monitoring programme in Cantanhez NP. Enhanced capacity to manage human-wildlife interactions is expected via increased knowledge from biomonitoring and participatory mapping and via the development of a One Health environmental management plan. | [redacted] |
| **Outcome**<br><br>Reduced risk of transmission of leprosy benefitting 28,000 people and threatened wildlife through behavioural change in public health, mitigated conflicts over conservation and disease, and improved protection of key habitat.<br><br>**Revised Outcome** | **0.1** By the beginning of Y4, capacity of the local health force to rapidly identify cases of zoonotic infections including leprosy is increased by 80% (n=8 health centres), and at least 25 of 50 households surveyed demonstrate improvement in health-related behaviours compared to baseline established in Y1. **Revised 0.1** By end of project, leprosy in humans and nonhuman primates is integrated into One Health strategies, and an | **0.1** A pre-training health-worker questionnaire to assess knowledge and capacity to diagnose leprosy by the local health force in CNP was partially implemented in Y1Q3 (10 interviews) and revised in Y2Q4 to include health agents. Cumura and AIFO have agreed to work with the Darwin Project to provide training to health workers (nurses, health agents, healers) and advise on leprosy messaging for the One Health campaign. Pre-training | **0.1** Additional interviews with health practitioners (nurses, health agents and healers) will be carried out by NADEL in Y3Q1-2. Training to nurses, health agents and traditional healers scheduled for Y3Q2-3. **New:** Up-to-date information about leprosy occurrence in wildlife and humans is combined into one report and shared with health stakeholders (WHO, Ministry of Health). One Health trial campaign fully implemented, and |

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|---|---|---|---|
| Improved knowledge and surveillance of leprosy in wildlife and humans, with enhanced capacity to manage human-wildlife interactions and support conservation and human health at Cantanhez NP. | evidence-based One Health campaign strategy is developed for Cantanhez NP.<br><br>**0.2** By the beginning of Y3, multi-stakeholder preparedness for leprosy outbreak and related conflicts is increased through the involvement of stakeholders (n=5 groups), compared to baseline zero. **Revised 0.4** By end of project, improved coordination between health and conservation stakeholders have enhanced institutional capacity to respond to zoonotic disease and disease-related conservation conflicts.<br><br>**0.3** By the beginning of Y4, wildlife associated with 12 protected forest blocks (c. at least 70km$^2$ across CNP) are surveyed for abundance and leprosy (primates). No decrease in primate abundance compared to baseline established in Y2. **Revised 0.2** By end of project, institutional capacity to monitor disease in wildlife in Cantanhez NP is increased to 80% compared to baseline (zero) through the implementation of biodiversity monitoring and the establishment of an IBAP surveillance team for sample collection and management of animal carcasses.<br><br>**0.4** By the end of Y3, there has been no loss of key habitat (in protected forest blocks) from baseline established in Y1. **Revised 0.3** By end of project, | questionnaires will be completed in Y3Q1-2. 101x household interviews were completed in Y2Q3. Potential health-related risk behaviours were identified via interviews and based on literature and data of the Cantanhez Chimpanzee Project (UoE, **Evidence 1.1 and 1.2**).<br><br>**0.2** A collaboration with key health organisations involved in leprosy work in Guinea-Bissau has commenced in Y2Q4 via in-person meetings with NADEL and Zoom meetings with project partners. Meeting attendants included three representatives from AIFO, one from Cumura Hospital, one from the WHO, and project partners NADEL, IBAP, CRIA and UoE (**Evidence 4.2**).<br><br>**0.3** The Biodiversity Monitoring Programme began in November 2019 with the selection of transects and camera trap locations (Y1Q3) and data collection (Y1Q4). COVID-19 safety protocol was developed by UoE and training was delivered in Y2Q1 to 8 DFOs and 2 RCs by the DPOs. Covid-19 health protective measures implemented in Y2Q1.<br><br>A camera trap survey area of 470 km$^2$, associated with 13 forest blocks and four corridor zones, was conducted in dry seasons Y1Q4–Y2Q2 (six months, **Evidence 2.6–2.11**). Spatial modelling is ongoing by DRF (**Evidence 3.1**). In Y2Q3 camera trap monitoring was resumed for the second dry season, with data collection ongoing. In addition | results are written up, including strategic plan for scale-up to Cantanhez NP.<br><br>**0.2** Meetings every four months (project partners and health stakeholders) throughout Y3. **New 0.4:** Up-to-date leprosy case mapping and literature review. Reports shared with partners and health stakeholders. Series of meetings to develop strategic plan with project partners and health stakeholders. Multi-stakeholder leprosy response plan written up.<br><br>**0.3** Continue BMP. Carry out intensive leprosy monitoring across three chimpanzee communities where leprosy has been identified (Y3Q1-2). **New 0.2:** Finalise carcass swabbing protocol, select surveillance team and carry out training (Y3Q3). Revise and finalise long-term protocol (Y3Q4).<br><br>**0.4 New 0.3:** Write up One Health environmental management plan (Y3Q3-4). Plan approved by project partners and local stakeholders (including management committee, Women's Associations). Conduct remote sensing and GIS training with IBAP technical team. |

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| | human-wildlife interactions related to One Health risks are incorporated into management strategies for Cantanhez NP, and at least 30% of IBAP's technical team have attended training in monitoring forest changes in protected forest blocks using remote sensing and GIS. | to the continued monitoring of leprosy progression in individuals from three chimpanzee communities, we identified 3 chimpanzees individuals showing advanced clinical manifestations of leprosy from two additional chimpanzee communities across the northern part of the park ("Faro Sadjuma" and "Quartel Guiledje", **Evidence 2.12**).<br><br>Leprosy monitoring using faecal sampling and 60 additional camera traps has commenced with training of two DFOs, two RCs and six local collaborators (**Evidence 2.3 and 2.4**). | |
| **Output 1.**<br><br>Reduced risks of leprosy transmission/outbreak in humans and disease-related conflicts (e.g., retaliatory killing of wildlife) through an evidence-based public health campaign across Cantanhez NP.<br><br>**Revised Output 1** Surveillance for leprosy disease in Cantanhez is increased and partner villages demonstrate improvement in understanding the links between environmental, animal, and human health. | **1.1** By the end of Y2, awareness campaign based on sociocultural data developed and implemented. By the end of Y3, at least 14,000 people (50% of the population including men and women) have engaged with campaign. **Revised 1.1** By the end of Y2, understanding of local knowledge and perceptions of disease is improved by at least 15% compared to baseline 5% (based on previous literature from Cantanhez NP) and potential risk factors for wildlife-to-humans disease transmissions are identified.<br><br>**1.2** By Y2 high-risk behaviours that encourage disease transmission identified, and by the beginning of Y4 high-risk behaviours reduced by at least 50% (in 50 households) from baseline established in Y1.<br><br>**1.3** By end of Y2, 80% health professionals at the 8 centres in | **1.1** Data collection to inform the development of the awareness campaign started in November 2019 and finished in December 2020 (interviews stopped in Y2Q1 due to Covid-19 situation and national restrictions). One hundred and forty-two (142) people were interviewed in total. One hundred and one household interviews to understand local knowledge and perceptions of disease, and identify potential risk factors, were carried out in Y2Q3. Data were analysed in Y2Q4 (**Evidence 1.2**). Data were presented during meetings with project partners in Y2Q4 (**Evidence 4.1 and 4.2**).<br><br>**1.2** Pre-campaign baseline data collection completed in December 2020 (101 households, two questionnaires 50/51, 27 villages). Data analysis was carried out by CRIA in Y2Q4; high-risk behaviours identified (**Evidence 1.2**). Please note, this indicator has now been revised and merged with Revised Indicator 1.1.<br><br>**1.3** Data collection to assess pre-training knowledge began in Y1Q4, with five nurses and five traditional healers interviewed. Data collection stopped during the first six months of the Covid-19 pandemic for safety reasons and due to health centres overloaded dealing with the Covid-19 response. Due to these delays, we now aim to complete pre-training interviews by Y3Q3, with at least 70 health professionals including nurses, health agents and healers involved. Training to | |

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| | Cantanhez have improved capacity to rapidly identify zoonotic disease, including leprosy. **Revised 1.2** By the middle of Y3, at least 80% of local nurses (N=6), health agents (N=50) and traditional healers (N=10) are trained to identify early symptoms of leprosy disease.<br><br>**1.4** By the end of Y3, public knowledge of zoonotic disease and transmission risks is improved in 90% of households (n=50), compared to Y1 baseline with less than 5% of households indicating negative perceptions of/attitudes towards wildlife concerning disease. **Revised 1.3** By the end of Y3, at least 50% of campaign participants (N=30 out of 60, including at least 50% women) demonstrate increased understanding in the links between environmental, animal and human health via One Health trial campaign in six partner villages compared to baseline pre-campaign. | local nurses, health agents and traditional healers is scheduled for Y3Q2-3. Training material is being developed with Cumura Hospital representative Dr Silvio Coelho and AIFO (human health). Training material will also include One Health concepts and messages about human-wildlife interactions, including the role of health workers in helping to mitigate risks of conservation conflicts over disease. The wildlife-related material is being developed first by UoE, IBAP and RKI, and will be finalised with NADEL, Cumura and AIFO.<br><br>**1.4** Based on the original LogFrame plan, pre-campaign data collection to measure public knowledge of zoonotic disease and transmission risks was completed in Y2Q3 via household interviews. **Revised 1.3:** Improved understanding in the links between human, animal, and environmental health will be assessed via pre- and post- One Health trial campaign questionnaires with 60 participants in Y3Q3-4. | |
| **Activity 1.1**<br>Training:<br><br>NADEL, CRIA and UoE DRF to train NADEL DPO in pre-campaign data collection, entry and analysis. | | Data collection strategy developed in Y1 and revised multiple times by CRIA, UoE and NADEL in Y2 based on COVID-19 situation.<br><br>Additional training to NADEL personnel was carried out by NADEL DPO in Y2Q3 to assist in data collection of household interviews.<br><br>Interview data conducted in Y2 were entered into Excel and shared to UoE by NADEL DPO. | Training on campaign co-ordination, data collection (campaign monitoring), report writing to NADEL DPO (campaign co-ordinator) scheduled for Y3Q1. |

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| **Activity 1.2**<br><br>Data collection: UoE DRF to conduct interviews to understand perceptions of disease and health services. NADEL DPO to collect questionnaire data to establish baseline: (1) identify high health risk behaviours in local communities (at least 50 households surveyed), and (2) assess capacity to identify and respond to disease outbreak at 8 local health centres. | In Y1, NADEL DPO carried out 31 exploratory interviews with women and men across CNP to gather a preliminary understanding of disease perception.<br><br>NADEL DPO conducted interviews with nurses (5x) and traditional healers (5x) to assess capacity to identify leprosy (including early stage).<br><br>Interviews stopped in Y2Q1 due to COVID-19 preventive measures.<br><br>In Y2Q2 NADEL DPO carried out participant observation with NADEL to gather information on people's response to COVID-19.<br><br>Household questionnaires (2x) were finalised by UoE DRF and CRIA in Y2Q3 based on 31 exploratory interviews carried out in Y1 and taking into consideration the COVID-19 pandemic situation. One questionnaire focussed knowledge of on five infectious diseases (Covid-19, common cold, leprosy, cholera, malaria). One questionnaire focussed on perceptions of disease transmission risks. Both questionnaires included questions about the use of health services, with the second questionnaire including perceptions of health services (**Evidence 1.1**).<br><br>Household questionnaires were implemented with 101 participants (50 and 51 participants per questionnaire) in Y2Q3. | Data collection with additional nurses, health agents and healers are scheduled for Y3Q1-2.<br><br>Pre- and post-campaign questionnaires with 60 participants (Y3Q3-4). |

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| | Two questionnaires, one for nurses and one for health agents, were developed in Y2Q4 by UoE, CRIA, NADEL and revision is ongoing with Cumura Hospital's Dr Silvio Coelho. | |
| **Activity 1.3**<br><br>UoE DRF, CRIA and NADEL DPO to analyse data, write report and disseminate to project partners. | NADEL DPO analysed Y2Q2 data (monitoring of Covid-19 situation and response), wrote and shared report to partners in September 2021. UoE, CRIA and NADEL conducted a follow-up Zoom meeting to discuss report and request extra information and clarifications in October 2021.<br><br>Data analysis of household questionnaires collected in Y2Q3 analysed by CRIA in Y2Q4 and results shared with project partners, including via Zoom meetings, in Y2Q4 (**Evidence 1.2 and 4.1**). | Analysis of pre-training interviews by NADEL DPO (Y3Q2). Report.<br><br>Analysis of pre-campaign data collection by NADEL DPO (Y3Q3). Report.<br><br>Analysis of post-campaign data collection by NADEL DPO (Y3Q4). Report. |
| **Activity 1.4**<br><br>NADEL, CRIA, UoE DRF to develop workshop health campaign strategy (using the data collected in 1.2). DPO and DRF to write up and finalise health campaign strategy. | Progress towards developing the health campaign trial now scheduled for Y3 was made via meetings with project partners in Y2Q3-4. On the 11th of March we held an initial workshop with UoE, CRIA, NADEL, presenting the results of the interviews. Our data suggested a lack of public awareness or willingness to share information about zoonotic diseases including COVID-19 (**Evidence 1.2**). During the meeting we therefore discussed the need for a more holistic approach for public health messaging, such as One Health, as well as an increased participatory approach such as training and discussion sessions with a selected group of residents (60 participants), and the use of theatre. | |

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| | During the meeting we also discussed ways in which leprosy in wildlife can be used as a disease example in One Health messages due to the highly visible characteristics of leprosy symptoms, particularly at advanced stages. | |
| **Activity 1.5**<br><br>Training:<br><br>NADEL and UoE to select and train 7 Health campaign DFO's | Selection of Health Campaign DFOs is ongoing. All potential DFOs have already received training on outreach methods and strategies in Y2Q2 by NADEL for the Covid-19 response.<br><br>Please note that under the revised plan, Health DFOs will largely focus on Revised activities under **Output 3**, as well as supporting the NADEL DPO during the One Health trial campaign planned for this Output. | Participatory mapping training with UoE DRF in Y3Q1 (**Revised Activity 3.2**). |
| **Activity 1.6**<br><br>NADEL DPO and DFOs and UoE DRF to run health campaign. NADEL DPO to coordinate 7 DFOs to conduct outreach activities, including group meetings in at least 70 of 110 villages (i.e. at least 14,000 people) across Cantanhez NP. PHASE 1 will be 9 months focusing in at least 70 villages throughout Cantanhez NP. PHASE 2 will be 4 months focussing on villages identified as high risk for leprosy transmission and/or conflict. NADEL DPO to monitor campaign via regular consultation with DFOs, meetings with partners, campaign data entry/analysis and reports shared with project partners every 3 months). | | Please note that this Activity has now been revised to a One Health trial campaign, scheduled for Y3Q3. |
| **Activity 1.7**<br><br>NADEL, UoE and RKI to carry out clinical training to health workers at 8 health centres. | | Scheduled for Y3Q3. Revised to include nurses, health agents and traditional healers. |
| **Activity 1.8**<br><br>NADEL DPO and DRF to evaluate impact of campaign. DRF to conduct interviews to compare perceptions of disease and health services to Y1. DPO to | | Revised and scheduled for Y3Q3-4. |

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| collect questionnaire data to compare to baseline: (1) high health risk behaviours in local communities (at least 100 household surveyed), and (2) capacity to identify and respond to disease outbreak at 8 local health centres. Interviews and questionnaires to be conducted with the same participants as Y1. Reports shared with partners every 3 months, final report by March Y4 | | | |
| **Output 2.**<br><br>Improved wildlife management capacity through the establishment of the **first health and abundance systematic monitoring programme** for key terrestrial biodiversity in Guinea-Bissau | **2.1** By Y2, the wildlife monitoring capacity in Cantanhez NP is increased by 100% compared to baseline zero. Eight DFOs and one DPO collect, enter and analyse data. **Revised 2.1** By Y2, the wildlife monitoring capacity in Cantanhez NP is increased to 80% compared to baseline 5% (based on number of park staff trained to record and analyse data, and existing training manuals).<br><br>**2.2** By the end of Y3, regular monitoring has improved knowledge of biodiversity and disease presence in 12 protected forest blocks (approximately 70km$^2$) across Cantanhez NP (including pilot data collected in 2018 - Halpin Urgency Grant). **Revised 2.2** By the end of Y3, regular monitoring has improved knowledge of biodiversity and disease presence across Cantanhez NP, including 12 protected forest blocks (approximately 70km$^2$) compared to pre-project baseline 20% (including pilot data collected in 2018 - Halpin Urgency Grant and PhD data by DRF collected in 2016-2017).<br><br>**New 2.3** By the end of Y3, institutional capacity to sample, handle and dispose wild animal carcasses securely is increased by 100% compared to baseline zero. | **2.1** Eight DFOs, two local research consultants (RCs) and two DPOs were trained in survey data collection in Y1 by the DRF. COVID-19 safety training was conducted by DPOs to 8 DFOs and 2 RCs in Y2Q1. Refreshment data collection training sessions were performed by DPOs to 8 DFOs and 2RCs at the start of the second season of the BMP. These included in Y2Q3 (habitat data collection, set up and maintain camera traps, GPS use and fill datasheets) and Y2Q4 (transect data collection using GPS and Cybertracker).<br><br>DPOs were trained on data entry and management in Y1 by the DRF. Throughout Y2 the DRF assisted the DPOs remotely via phone meetings and emails. Data entered by DPOs and shared with DRF every 1-2 months (Excel tables and SMART data) in Y2Q1-2 for first monitoring season and again in Y2Q3-4 once data collection resumed for the second season. Distribution data of primates and ungulates were obtained (**Evidence 2.11 and 3.1**). A report summarising Season 1 of the BMP was written and shared by DPOs in Y2Q3 (**Evidence 2.9**). External hard drive containing all 2020 data including camera trap footage delivered to DRF in January 2021.<br><br>**2.2** Approximately 0.7 terabytes of Season 1 biomonitoring camera trap data and associated information (GPS, deployment information) imported into a computer and three external hard drives by the two DPOs in Y2. DPOs and DRF have reviewed 100% of camera trap data obtained in Y1Q4–Y2Q2. Review and classification of season 2 camera trap data ongoing (two months of data classified so far).<br><br>Data gathered in the first biomonitoring season (Y1Q4-Y2Q2) include 6 months of camera trap data (7514 camera trap days), and 208km of transect survey effort. Data collection covered 540 km$^2$ in association with 13 forest blocks and four main corridor zones. Leprosy disease occurrence was identified in the north of the park in three additional chimpanzee communities, with two individuals showing advanced stage leprosy, and three individuals showing possible signs. Leprosy was also identified in three groups of baboons across the park (**Evidence 2.12**) and confirmed via molecular analysis in the Caiquene-Cadique group (**Evidence 2.13**). Camera trap spatial models and distance sampling |

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| | **2.3** By the beginning of Y4, monitoring programme evaluated and incorporated into IBAP's long- term management of Cantanhez NP. (Revised as **2.4**) | analysis ongoing (Y2Q4-Y3Q1). Spatial models of four primates show distinctive distribution patterns in chimpanzees and other primates (**Evidence 3.1**).<br><br>Targeted leprosy monitoring in chimpanzees with additional camera traps and intensive faecal sampling will commence in Y3Q1. Targeted leprosy monitoring will involve an additional 60 camera traps and 1200 faecal samples spread across three chimpanzee communities where leprosy is present (**Evidence 2.3**). Material was shipped to Bissau in Y2Q4 and training with DPOs is ongoing. The aim of this research is to quantify disease prevalence in chimpanzees (i.e. number of chimpanzees carrying the disease in relation to chimpanzee community size) using DNA profiling and leprosy identification. Targeted camera traps will be used to monitor disease progression and gather data on social relationships amongst individuals.<br><br>**New 2.3** RKI and UoE will work with IBAP and NADEL to develop and implement a protocol for the handling and management of dead chimpanzees (e.g. carcasses found in the forest, or due to retaliatory killings) to prevent disease transmission and increase scientific knowledge on disease present in wildlife in Cantanhez. This will involve training a IBAP team for carcass swabbing, data collection, sample handling and management, as well as a communication chain from local people to community guards, IBAP and UoE when a carcass is identified (including what to do when encountering a dead animal, who to contact). Training in carcass swabbing is scheduled for Y3Q3.<br><br>**2.3/2.4** Evaluation is ongoing using season 1 biomonitoring data. The protocol was written up in October 2019 (Y1Q3) and revised in March 2020 (Y1Q4) upon completion of establishment and mapping of survey locations (camera traps and transects). The protocol is under third revision based on season 1 report by DPOs and data analysis (ongoing by UoE). Transect data collection methods by the DFOs – specifically, Cybertracker vs. GPS and datasheets – are under evaluation (via comparison, consultation with IBAP and analysis). This was discussed during our M&E meeting in Y2Q4 with IBAP and we are currently evaluating the methods to ensure that the protocol will be applicable to other Protected Areas across the country upon completion of this project. | |
| **Activity 2.1**<br><br>IBAP and UoE to train IBAP DPO and eight DFOs in data collection (8 DFOs: wildlife survey, primate faecal sampling; DPO: data management and analysis, report writing) | | Camera trap and transect survey training sessions were delivered to two DPOs, eight DFOs and two local RCs by the DRF in Y1 (November-February 2019). Training included (i) establishing and mapping transect routes, (ii) camera trap programming, set up and maintenance, (iii) distance sampling, | Faecal sampling data collection and management training to DPOs by PhD student Marina Ramon and DRF completed in Y3Q1 (**Evidence 2.3**). |

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| | (iv) survey data collection using Cybertracker, (v) data entry and processing using SMART, (vi) camera trap data classification, organisation and storage, (vii) GPS data management in Basecamp.<br><br>**Year 2**<br><br>Refreshment trainings and trouble-shooting exercises on data import, export and sharing were carried out with DPOs throughout Y2 by DRF (remotely).<br><br>DPOs delivered refreshment training to DFOs and RCs on (i) SMART data collection via Cybertracker in Y2Q2 and Y2Q4, and (ii) camera trap set up and maintenance in Y2Q3.<br><br>DPOs delivered training to DPOs on habitat data collection every 100m along transects using GPS and datasheet in Y2Q3 (**Evidence 2.2**).<br><br>DPOs delivered training based on Covid-19 health and safety protocol in Y2Q2. | DPOs training of six collaborators and two RCs in faecal sampling ongoing.<br><br>Camera trap set up and maintenance training by DPOs and RCs to six local collaborators ongoing.<br><br>Additional training on data analysis scheduled to be delivered in Y3 by DRF to DPOs.<br><br>Refreshment training sessions Y3. |
| **Activity 2.2**<br><br>UoE and IBAP DPO to establish survey areas (transects and camera trap sites) | Survey sampling sites were established in Y1 (64 transects and 48 camera traps).<br><br>Survey sampling sites are currently under revision based on data analysis (Y2Q4-Y3) and discussions with DPOs (Y2Q4). Additional transects in the north of the park are under consideration. | |

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| **Activity 2.3**<br><br>IBAP and UoE to coordinate monitoring programme. 8 DFOs to walk transects across all major forest blocks to collect survey data for primates, set up and maintain camera traps, collect faecal samples. Camera traps will be set up systematically (at least 60 independent sampling points, covering different habitat types) for 2 months during the dry season each year. Transect surveys and faecal sampling will be conducted in both dry and rainy seasons. | Survey activities paused in March 2020 due to IBAP temporarily halting all research activities in PAs due to the potential risks of the Covid-19 pandemic. Survey activities resumed in May 2020 following conversations with IBAP about the need to continue research whilst minimising the risks of disease spread via the establishment of a strict hygiene protocol for data collection (**Evidence 2.1 and 2.6**).<br><br>UoE DRF coordinated biomonitoring programme with DPOs remotely via regular WhatsApp calls, messages and email with DPOs. Data collection in Cantanhez was carried out by 8 DFOs and two RCs, coordinated by the DPOs.<br><br>**Season 1 BMP (Jan - July 2020)**<br><br>Transect surveys resumed in May 2020 with two repetitions per transect before stopping in July 2020 for the rainy season. The total survey effort of the first biomonitoring season is 208km (137km in Y2, 71km in Y1).<br><br>Camera traps remained operational throughout Y2Q1 until July 2020. Camera traps were checked by the DPOs during their transect surveys. The total camera trap sampling effort for the first survey season equalled to 7514 camera trap days. Of the 48 camera traps, two were stolen before any data were retrieved, three were stolen in Y2Q1. Eight camera traps were moved during the survey season. The number of survey sites during the | Continue data collection on transects (64km every month) and camera trap maintenance by DFOs.<br><br>Faecal sampling will begin in Y3Q1. We aim to obtain 1200 samples from 600 independent chimpanzee stools (2 samples per stool). Half of the samples will be stored in RNAlater for identification of leprosy presence. The other half of the samples will be stored in silica gel for DNA profiling (chimpanzee individual ID). Faecal sampling will take place across three chimpanzee communities (**Evidence 2.3**).<br><br>An additional 60 camera traps will be established in Y3Q1 to monitor progression of leprosy in infected chimpanzee individuals (**Evidence 2.3**). |

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| | first biomonitoring season was 54 (52 independent sites, see **Evidence 3.1**).<br><br>**Season 2 BMP (Dec 2020 - ongoing)**<br><br>The 43 camera traps were set up again in December 2020 by the DPOs, DFOs and RCs. Three cameras malfunctioned and recorded no data. The total effort for Y2 Season 2 camera trap surveys is 4370 camera trap days from 40 camera trap sites.<br><br>Transect surveys restarted in January 2021 and 57 transects have been repeated three times each up to end of Y2 (192km of survey effort) (**Evidence 2.7 and 2.10**).<br><br>Additional camera trap material (including 65x camera traps, 50x security cases, 100x locks, 3520x AA alkaline batteries 300x SD cards), survey equipment (5x GPSs), hard drives and faecal sampling material was delivered to Bissau in March 2021. | |
| **Activity 2.4**<br><br>IBAP DPO to monitor progress of wildlife monitoring programme via data entry and meetings with DFOs and UoE. Data and report shared with project partners every three months. | Transect survey data (Cybertracker, GPS, datasheets) were entered and processed in SMART (**Evidence 2.6 and 2.7**), patrol observation queries and patrol summary), Basecamp and Excel. Data were shared by DPOs to DRF every 1-2 months during data collection (April 2020, June 2020, July | Continue with data entry (every month) and sharing (every 2-3 months), including data from transect and camera trap surveys as well as from the intensive leprosy monitoring (faecal samples and 60 additional camera traps), which will include Excel (faecal |

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| | 2020, and again in November 2020, December 2020, February 2021, March 2021).<br><br>Camera trap summary data on Excel (number of photos per species, check-up dates) was shared by DPOs to DRF every 2-3 months during data collection periods (April 2020, May 2020, August 2020, and again in February 2021).<br><br>All data were stored in three external hard drives by the DPOs. One hard drive (including raw and classified camera trap data) was shared by DPOs to DRF in Y2Q4 (delays were due to the fact that we could not ship hard drives via DHL due to anti-terrorism laws forbidding the shipment of electronic materials from Guinea-Bissau to Europe. We had to find someone travelling to Europe to bring the hard drive and ship it to the UK).<br><br>All data are now backed up in 5 external HDs (2 at IBAP, including the second seasons' camera trap data, 3 at UoE).<br><br>Meetings between DRF and DPOs were carried out every two weeks via WhatsApp/phone calls, with more frequent contact (every week, sometimes daily) via WhatsApp messaging (text and audio) and calls when needed.<br><br>Three reports were written up by DFOs and shared with DRF in Y2 (April 2020, September/October 2020, March 2021). | sample collection, camera trap data summary) and GPX files.<br><br>Additional reports by DPOs due in Y3Q2 (end of second season surveys), Y3Q3 (start of third season surveys) and Y3Q4 (progress report). |

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| **Activity 2.5**<br><br>Sample handling and analysis:<br><br>IBAP DPO to transport faecal samples to Bissau every 2 months (to be stored at IBAP). RKI to organise shipping and import permits, IBAP to ship faecal samples to RKI (Germany) every 6 months. RKI to analyse samples and send project partners the results every 3 months. | Due to the COVID-19 pandemic we had to delay the start of data collection of faecal samples (originally scheduled for Y2Q2). During the pandemic, RKI labs were mainly being used for COVID-19-related analyses.<br><br>RKI have completed analyses of baboon faecal samples in Y2Q4 and shared results with project partners (**Evidence 2.13).**<br><br>Faecal sampling material was delivered to IBAP in March 2021 via DHL (Y2Q4). | Samples will be securely stored at IBAP headquarters in Cantanhez and transported to Bissau for shipment/transport to UoE and RKI in Y3Q2. |
| **Activity 2.6**<br><br>Evaluation (data analysis):<br><br>IBAP DPO and UoE DRF to evaluate programme via data analysis (i.e. obtain indices of abundance, map primate distribution and leprosy occurrence). Report write up and share with project partners every 6 months. UoE to conduct land classification analysis of Y1 and Y3 satellite imagery (end of Y3) | **Season 1 BMP (Jan - July 2020)**<br><br>The first evaluation of the monitoring programme is in progress via data analysis. Analysis of Season 1 BMP includes distance sampling analysis by UoE and INLA-SPDE spatial modelling by DRF (**Evidence 3.1**).<br><br>From the first season of **transect surveys** (Y2Q4) we obtained 514 animal observations of 15 species; 101 direct observations were of primates), and 241 observations of human activities, which will be used to establish baseline of abundance (encounter rates of all species, density of chimpanzee, colobines and Campbell's monkey). Density estimates of chimpanzees, Campbell's monkeys and colobus monkeys ongoing (Y2Q4-Y3Q1).<br><br>All **camera trap** images were checked by DPOs as part of the chimpanzee | Complete data analysis of Season 1 BMP and write up by end of Y3Q2. Report sharing to project partners.<br><br>Analysis of Season 2 data completed and written up by end of Y3Q3. Report sharing to project partners.<br><br>Faecal samples analysis completed by Y3Q4. Report sharing to project partners. |

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| | health monitoring programme. All classified camera trap data checked by DRF.<br><br>Camera traps data resulted in 2272 independent events of primates and 1686 independent events of ungulates, which are used to model intensity of use/presence across the park. See **Evidence 3.1** for primate spatial models).<br><br>New data on leprosy occurrence obtained in Y2Q2; additional chimpanzee and baboon individuals with leprosy symptoms identified across the north of the park (**Evidence 2.12**).<br><br>Report including summaries of data obtained written up and shared by DPOs in Y2Q3. Preliminary results presented by DPOs during M&E meeting in Y2Q4 (**Evidence 2.11**).<br><br>**Season 2 BMP (Dec 2020 - ongoing)**<br><br>From the second season of **transect surveys** (Y1Q2-Y2Q2), the total number of animal observations so far is 497 of 16 species. 84 observations are direct primate observations. The total number of observations of human activities so far is 79. | |
| **Activity 2.7**<br><br>Develop long term protocol: | Revision of the BMP protocol is scheduled for Y2Q4 and is ongoing. The methodology for data collection | Y3Q4 finalise protocol. |

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| UoE and IBAP to finalise wildlife monitoring protocol (including detailed procedures for data collection, data entry, data management and analysis) to be incorporated by IBAP in long-term management plan for Cantanhez NP (By end of Y3) | | was discussed with IBAP during the M&E meeting in March 2021.<br><br>The protocol includes the objectives and methodology, the data collection strategy, data management and analysis.<br><br>The protocol also includes training material/strategies to ensure long-term sustainability (i.e. for new project members, scale up nationally) beyond Darwin project ends. | |
| **Output 3.**<br><br>A human-wildlife interaction plan that extends protection of key wildlife habitat, and incorporates new regulations in areas of high human-wildlife interactions, including leprosy transmission risk, is developed for Cantanhez NP.<br><br>**Revised Output 3**<br><br>A One Health environmental management plan to promote healthy human-wildlife coexistence and strengthen multi-stakeholder decision-making capacity in Cantanhez NP. | **3.1** By end of Y2, key wildlife habitat including corridors, and areas of high risk of leprosy transmission are identified using monitoring data and faecal analysis. **Revised 3.1** By the middle of Y3, key wildlife habitat including corridors, and areas of high human-wildlife interaction and potential disease transmission are identified.<br><br>**3.2** By the end of Y3, the plan is developed with stakeholders (IBAP, Management Committee and other group representatives including from the Cantanhez Women's Associations) comprising at least 50% women. **Revised 3.2** By the end of Y3, the plan is developed with stakeholders (Management Committee and other group representatives including from the Cantanhez Women's Associations) comprising at least 50% women.<br><br>**3.3** By the beginning of Y4, the plan is written by IBAP and formally agreed by IBAP and local communities. **Revised** | **3.1** Full data sharing (including all camera trap data) was delayed due to the COVID-19 pandemic. Specifically, external hard drives could not be shipped from Bissau due to anti-terrorism restrictions and we therefore had to ask someone travelling to Europe to bring the hard drives, which were retrieved by UoE in Y2Q4. Spatial modelling of camera trap and transect data is ongoing (**Evidence 3.1**).<br><br>Key wildlife habitat including corridors will be identified using spatial models of key wildlife species (primates and ungulates, high intensity of use, abundance, species richness) and occurrence sites of rare species (giant pangolin, African golden cat). Corridors are defined as areas that are essential to allow species movement across forest refuges.<br><br>Hotspot areas of potential disease transmission risks will constitute areas of high spatial overlap between humans and primates. Hotspots may comprise specific villages and agricultural areas. For disease transmission risks we consider the occurrence of leprosy in chimpanzees and potentially baboons, as well as transmission of other zoonotic diseases (e.g. Covid-19, common cold, tuberculosis) between humans and primates, which will be modelled via participatory mapping scheduled in Y3 (**New Activity 3.3**).<br><br>This indicator was revised to accommodate the COVID-19 related delays and newly added participatory mapping activities (**3.2**, **3.3**, **3.6**). | |

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| | **3.3** By the beginning of Y4, the plan is written up by project partners and agreed by IBAP and local communities. | **3.2** The plan was discussed during our M&E meeting in March 2021 and IBAP highlighted the importance of it to inform initiatives and activities in Cantanhez NP. Spatial model maps will be shared with IBAP in Y3Q1-2. Meetings will be carried out in Y3 with local stakeholders (incl. local management committee and Women's Associations), to discuss the maps generated and identify aspects of human-wildlife interactions related to One Health to take into consideration, such as sites where resources are shared (water points, cultivated foods).<br><br>The development of the plan will be achieved during a multi-stakeholder workshop in Y3Q3, which will include asking participants to propose measures to minimise pathogen transmission. | |
| **Activity 3.1**<br><br>**Data analysis:**<br><br>UoE to analyse spatial data and create human-wildlife interaction hotspot maps of the whole Cantanhez NP, based on Y1 and Y2 wildlife monitoring programme data (wildlife survey and faecal sample data) and human social data (risk behaviour) | | Spatial modelling using camera trap data started by DRF in Y2Q4 and is ongoing (**Evidence 3.1**). Transect data analysis ongoing by UoE (started in Y2Q4).<br><br>Social data analysed in Y2Q4 by CRIA (**Evidence 1.2**). | Participatory mapping to identify fine-scale risk sites within hotspots identified in spatial models.<br><br>Tree nursery: already started at IBAP headquarters. We're starting to develop ideas on how this can be a technical strategy for the long-term. |
| **Activity 3.2**<br><br>**Results dissemination:**<br>UoE and RKI write up results and disseminate to project partners | | | Output models of Season 1 of BMP data shared with project partners (Y3Q2).<br><br>Participatory mapping report shared with project partners (Y3Q3). |
| **Activity 3.3**<br><br>**Develop strategy:**<br>UoE and IBAP to meet with local communities to present and discuss human-wildlife interaction maps | | | Scheduled for Y2Q2-3 (**Revised Activity 3.4**) |

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| **Activity 3.4**<br><br>**Workshop:**<br><br>Local community representatives (incl. Women's Associations, regional chieftains, health workers) and all project partners participate in workshop to develop a human-wildlife interaction plan that focuses on management of high risk areas (according to disease prevalence, land use, human behaviour, high human-primate spatial overlap) | | | Originally scheduled for Y3Q2, now rescheduled to Y3Q3 due to COVID-19 related delays. |
| **Activity 3.5**<br><br>**Draft plan:**<br>UoE to draft of human-wildlife interaction plan including maps and workshop proceedings and share with local communities and project partners | | | Scheduled for Y3Q3. |
| **Activity 3.6**<br><br>**Finalise plan:**<br>UoE and IBAP to finalise multi-stakeholder human-wildlife interaction plan and share with local communities and project partners. | | | Scheduled for Y3Q4. |
| **Output 4.**<br><br>Increased long-term readiness for potential public zoonotic threats and disease-related conflicts through the initiation of an **outbreak preparedness and response strategy** in Cantanhez NP.<br><br>**Revised Output 4**<br>Increased long-term readiness for potential public zoonotic threats and disease-related conflicts through the development of a **multi-stakeholder leprosy response plan** for Cantanhez NP. | **4.1** By beginning of Y4, improved coordination, communication and collaboration amongst health and conservation stakeholders compared to baseline (zero). **Revised 4.1** By Y2, key health organisation focal points are identified. By the beginning of Y3, regular communication and collaboration between health and conservation organisations is established.<br><br>**4.2** By beginning of Y3, infectious zoonotic disease response strategy drafted and sources of financial aid to cover human medical treatment identified (e.g. Ministry of Health | **4.1** The annual M&E meeting with IBAP, CRIA and NADEL took place on 23rd of March 2021 (Y2Q4). Fabian Leendertz from RKI was unable to attend due to urgent work as part of the WHO COVID-19 team. The PI met separately with Fabian Leendertz on the 18th and 31st March 2021 to discuss project progress and plans. In Y2Q4 project partners met with Dr Coelho (Cumura Hospital), four representatives of AIFO, Mireille da Rosa Fernandes Pereira (WHO consultant) to initiate collaboration with key health stakeholders. UoE presented our leprosy research findings so far, as well as the Darwin project (Outputs, key activities) (**Evidence 4.3 and 4.6**). Regular communication will be maintained over email to inform on project activities and exchange information and knowledge.<br><br>**4.2** Financial cover for the treatment of leprosy is provided by WHO (confirmed by WHO consultant and Cumura).<br><br>Progress has been made in Y2Q4 during the annual M&E meeting and meetings with health organisations (AIFO, Cumura, WHO). Project partners and health organisations have agreed to share data. | |

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| | Guinea- Bissau, WHO). **Revised 4.2** By the middle of Y3, multi-stakeholder knowledge of leprosy occurrence in humans and wildlife is improved via up-to-date case mapping.<br><br>**4.3** By beginning of Y3, a response strategy in the event of retaliatory killings of protected wildlife developed and agreed by IBAP and community representatives. **Revised 4.3** By Y4, institutional knowledge to manage and respond to conflicts over leprosy disease (including mistrust of health services, retaliatory behaviour towards animals) and leprosy in humans is increased via the production of the first multi-stakeholder leprosy response plan in Guinea-Bissau. | | |
| **Activity 4.1**<br><br>Opening meeting:<br><br>Opening meeting with project partners and stakeholders. Present project objectives and timeline, establish roles and responsibilities. Meeting proceedings written up and distributed to project partners. | | Conducted in Y1 | |
| **Activity 4.2**<br><br>M&E meetings:<br><br>Project partners to meet for annual M&E (Year 1 Bissau, Year 2 Lisbon, Year 3 UK) | | Y1 M&E meeting was carried out on 6th February 2020 with IBAP, NADEL, CRIA and UoE in Bissau.<br><br>Y2 M&E meeting carried out on 23rd of March 2021 with IBAP, NADEL, CRIA and UoE, over Zoom. UoE DRF presented progress of Y2 (Outputs and | Y3 meeting scheduled for Y3Q4. |

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| | activities). CRIA presented data obtained for Output 1 (**Evidence 4.1**). IBAP DPOs presented Output 2 activities and data obtained from the first biomonitoring season (**Evidence 2.11**). UoE DRF presented workplan for Y3 (Output and activities). Project partners discussed achievements and activities of Y2, as well as Y3 strategy for each Output and meetings schedule.<br><br>An additional meeting with IBAP, CRIA and NADEL was carried out on the 5th of May 2021 to revise the plan and produced a revised LogFrame (**Annex 2.1**). | |
| **Activity 4.3**<br><br>Identify and engage:<br><br>All project partners to identify and engage with relevant organisation focal points (incl. Ministry of Health, hospitals in Bissau and WHO) for inclusion in the response strategy | Progress has been made via meetings with relevant persons and organisations, including **Dr Magda Robalo** (Public Health Ministry, now High Commission for the fight against Covid-19 and Ebola), Dr Silvio Coelho (**Cumura Hospital and High Commission for the fight against Covid-19 and Ebola**), Mireille Pereira (**WHO**) and Arniel Silot, Giovanni Gazzoli, Michele Falavigna and Elisabetta Quattrocchi (**AIFO**). Meetings were held on 19th and 22nd of March (Y2Q4). Participants agreed to collaborate and use a One Health approach, taking into consideration the complexities of human-wildlife interactions (i.e. risks of conflicts, retaliatory killings) and the stigma | Information sharing via regular emails (every month) and meetings throughout Y3. |

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| | surrounding leprosy disease in humans. | |
| **Activity 4.4**<br><br>Workshop:<br><br>Project partners to hold workshop to develop long-term disease readiness and conflict mitigation strategy (in collaboration with local stakeholders, incl. Nalu chieftains, Women's Associations, health workers, and focal points of relevant organisations, incl. WHO, hospitals in Bissau, Ministry of Health) | The workshop was originally scheduled for Y2Q4. The development of the plan is now scheduled for Y3Q3 via meetings (**Revised Activity 4.9**). | See also **Revised Activities 4.5 – 4.8** |
| **Activity 4.5**<br><br>Write strategy:<br><br>Project partners to write response strategy to be approved by key organisations and local stakeholders. UoE, CRIA and IBAP to write up conflict mitigation and response strategy. NADEL and other key health organisations to write up disease outbreak response strategy. | Originally, scheduled for Y2Q4-Y3Q1, rescheduled for Y3Q3-4. | |
| **Activity 4.6**<br><br>Monitoring and evaluation:<br><br>NADEL DPO and IBAP DPO to monitor and evaluate the conservation/disease related strategies via meetings and reports every 3 months | Activity removed following MTR comments. | |

## Annex 2: Project's full current logframe as presented in the application form (unless changes have been agreed)

| Project summary | Measurable Indicators | Means of verification | Important Assumptions |
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| **Impact:**<br>Improved public health through increased resilience to infectious disease outbreaks in local communities, with improved capacity to manage threatened biodiversity and human-wildlife interactions, at Cantanhez National Park, Guinea-Bissau. | | | |
| **Outcome:**<br>Reduced risk of transmission of leprosy benefitting 28,000 people and threatened wildlife through behavioural change in public health, mitigated conflicts over conservation and disease, and improved protection of key habitat | 0.1 By the beginning of Y4, capacity of the local healthforce to rapidly identify cases of zoonotic infections including leprosy is increased by 80% (n=8 healthcentres), and at least 25 of 50 households surveyed demonstrate improvement in health-related behaviours compared to baseline established in Y1<br><br>0.2 By the beginning of Y3, multi-stakeholder preparedness for leprosy outbreak and related conflicts is increased through the involvement of stakeholders (n=5 groups) in a response strategy to mitigate and control leprosy outbreaks and conflicts, compared to baseline zero.<br><br>0.3 By the beginning of Y4, wildlife associated with 12 protected forest blocks (c. at least 70km$^2$ across CNP) are surveyed for abundance and leprosy (primates). No decrease in primate abundance compared to baseline established in Y2.<br><br>0.4 By the end of Y3, there has been no loss of key habitat (in protected forest blocks) from baseline established in Y1. | 0.1 Pre- and post- clinical training questionnaires to health professionals Y1 and Y3, and visits to hospitals by Darwin Project Officer 1. Social data from Darwin Research Fellow<br><br>0.2 Response strategy to mitigate and control leprosy outbreaks and conflicts developed. Number of workshops/meetings and attendees, number of group/organisation representatives.<br><br>0.3 Data collection (transects, faecal sampling and cameratrap surveys) and analysis (RKI, DPO, IBAP, UoE).<br><br>0.4 Land classification analysis of satellite imagery from Y1 and Y3. | Anonymous data shared for all patients and records kept appropriately by health workers (health data was previously shared during cholera outbreak with NADEL). Training of health workers in file management and confidentiality.<br><br>Stakeholders, including partners and key local collaborators such as the Womens Association, remain engaged and committed to improve health throughout the project<br><br>Local community leaders and IBAP remain committed to developing an evidence-based conservation strategy to reduce the risk of potential leprosy transmission, including protection of key wildlife habitat and monitoring of high-risk areas<br><br>Country remains politically stable (since its inception IBAP has remained unaffected by political instability and our research team has experienced no problems working in Cantanhez NP). |

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| **Output 1**<br><br>Reduced risks of leprosy transmission/outbreak in humans and disease-related conflicts (e.g. retaliatory killing of wildlife) through an **evidence-based public health campaign** across Cantanhez NP. | 1.1 By the end of Y2, awareness campaign based on sociocultural data developed and implemented. By the end of Y3, at least 14,000 people (50% of the population including men and women) have engaged with campaign.<br><br>1.2 By Y2 high-risk behaviours that encourage disease transmission identified, and by the beginning of Y4 high-risk behaviours reduced by at least 50% (in 50 households) from baseline established in Y1.<br><br>1.3 By end of Y2, 80% health professionals at the 8 centres in Cantanhez (which 28,000 people can access for healthcare within the NP) have improved capacity to rapidly identify zoonotic disease, including leprosy.<br><br>1.4 By the end of Y3, public knowledge of zoonotic disease and transmission risks is improved in 90% of households (n=50), compared to Y1 baseline with less than 5% of households indicating negative perceptions | 1.1 Data collection by Darwin Reseach Fellow, workshop to develop campaign completed, training attendance certificates and campaign activities of Health DFO's. Records of people involved in group discussions and other campaign activities including through media by DFO's.<br><br>1.2 Pre- and post-campaign data collection.<br><br>1.3 Training attendance certificates. Pre- and post- clinical training data collection.<br><br>1.4 Pre- and post-campaign data collection. | Health DFO's remain active and engaging throughout the campaign, and the local communities are willing to dedicate time and engage in activities throughout the duration of this project.<br><br>Risks of leprosy-related retaliatory behaviour towards wildlife are reduced by increasing the public's knowledge about zoonotic disease (including information about transmission risks, mitigation strategies associated with human behaviour, leprosy disease life cycle, health care provision by the local and regional health institutions).<br><br>The presence of leprosy in chimpanzees at Cantanhez is not discussed with and sensationalised by the media (to avoid this, we have a signed confidentiality agreement between IBAP, NADEL and researchers). |

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| | of/attitudes towards wildlife concerning disease. | | |
| **Output 2**<br>Improved wildlife management capacity through the establishment of the **first health and abundance systematic monitoring programme** for key terrestrial biodiversity in Guinea-Bissau | 2.1. By Y2, the wildlife monitoring capacity in Cantahez NP is increased by 100% compared to baseline zero. Eight DFOs and one DPO collect, enter and analyse data.<br><br>2.2 By the end of Y3, regular monitoring has improved knowledge of biodiversity and disease presence in 12 protected forest blocks (approximately 70km$^2$) across Cantanhez NP (including pilot data collected in 2018 - Halpin Urgency Grant).<br><br>2.3 By the beginning of Y4, monitoring programme evaluated and incorporated into IBAP's long-term management of Cantanhez NP. | 2.1 Training course certificates of attendance. Data entry and analysis.<br><br>2.2 Data collection, analysis and report written up. Samples analysed for presence/absence of leprosy and results written up.<br><br>2.3 Conservation management programme published on IBAP's website. | Partner organisation staff (IBAP) continue to be employed during and beyond the completion of this project (and find substitutes if necessary).<br><br>Please note: In this project we do not cover wildlife treatment costs. Chimpanzees and other primates have intentionally not been habituated to researcher presence, making the darting and treatment of infected individuals extremely complicated, costly and ethically questionable.<br><br>Please note: the monitoring programme focuses on all wildlife (including six primate species, ungulates, rodents, small carnivores). This is important because the wildlife reservoirs for leprosy are currently unknown. |
| **Output 3**<br>A human-wildlife interaction plan that extends protection of key wildlife habitat, and incorporates new regulations in areas of high human-wildlife interactions, including leprosy transmission risk, is developed for Cantanhez NP | 3.1 By end of Y2, key wildlife habitat including corridors, and areas of high risk of leprosy transmission are identified using monitoring data and faecal analysis.<br><br>3.2. By the end of Y3, the plan is developed by stakeholders (IBAP, Management Committee and other group representatives including from the Cantanhez Women's | 3.1 Production of human-wildlife interaction hotspot maps and report.<br><br>3.2 Pre-plan meetings and 2-day workshop delivered (N of attendees and group representatives). Consensus achieved.<br><br>3.3 Plan formally signed by IBAP and local community representatives at Cantanhez NP. | Partners and local stakeholders remain committed to engage in project meetings and workshop.<br><br>Consensus is achieved for the plan.<br><br>No unresolvable conflict occurs between local communities and partners during the course of this project. |

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| | Associations) comprising at least 50% women.<br><br>3.3 By the beginning of Y4, the plan is written by IBAP and formally agreed by IBAP and local communities. | | |
| **Output 4**<br><br>Increased long-term readiness for potential public zoonotic threats and disease-related conflicts through the initiation of an **outbreak preparedness and response strategy** in Cantanhez NP. | 4.1 By beginning of Y4, improved coordination, communication and collaboration amongst health and conservation stakeholders compared to baseline (zero)<br><br>4.2 By beginning of Y3, infectious zoonotic disease response strategy drafted and sources of financial aid to cover human medical treatment identified (e.g. Ministry of Health Guinea-Bissau, WHO)<br><br>4.3 By beginning of Y3, a response strategy in the event of retaliatory killings of proteced wildlife developed and agreed by IBAP and community representatives | 4.1 N of representatives for each group/institution attending regular meetings. N of reports shared amongst partner organisations.<br><br>4.2 Strategy written up and distributed to stakeholders.<br><br>4.3 Pre- and post-strategy meetings and 2-day workshop delivered (N of attendees and group representatives). Strategy written up in report. | Stakeholders recognise the long-term importance of the strategy and remain committed throughout and beyond the completion of this project.<br><br>Roles and responsibilities in mitigation strategies and response to emergencies are fully accepted and recognised by partners and stakeholders.<br><br>Response team and stakeholders take responsibility to find substitutes if necessary.<br><br>Please note: In this project we do not cover human medical treatment costs. When developing the long-term response strategy we will identify funding for treatment costs, as was done previously (in collaboration with NADEL) during a recent cholera outbreak. WHO offer free leprosy treatment. |
| **Activities** (each activity is numbered according to the output that it will contribute towards, for example 1.1, 1.2 and 1.3 are contributing to Output 1)<br><br>1.1 NADEL and DRF to train NADEL DPO in pre-campaign data collection, entry and analysis | | | |

1.2 Data collection: DRF to conduct interviews to understand perceptions of disease and health services. DPO to collect questionnaire data to establish baseline: (1) identify high health risk behaviours in local communities (at least 50 households surveyed), and (2) assess capacity to identify and respond to disease outbreak at 8 local health centres

1.3 DRF and DPO to analyse data, write report and disseminate to project partners

1.4 NADEL, CRIA, DRF to develop workshop health campaign strategy (using the data collected in 1.2). DPO and DRF to write up and finalise health campaign strategy

1.5 NADEL and UoE to select and train 7 Health campaign DFO's

1.6 NADEL DPO and DFOs and DRF to run health campaign. DPO to coordinate 7 DFOs to conduct outreach activities, including group meetings in at least 70 of 110 villages (i.e. at least 14,000 people) across Cantanhez NP. PHASE 1 will be 9 months focusing in at least 70 villages throughout Cantanhez NP. PHASE 2 will be 4 months focussing on villages identified as high risk for leprosy transmission and/or conflict. NADEL DPO to monitor campaign via regular consultation with DFOs, meetings with partners, campaign data entry/analysis and reports shared with project partners every 3 months)

1.7 NADEL, UoE and RKI to carry out clinical training to health workers at 8 health centres

1.8 NADEL DPO and DRF to evaluate impact of campaign. DRF to conduct interviews to compare perceptions of disease and health services to Y1. DPO to collect questionnaire data to compare to baseline: (1) high health risk behaviours in local communities (at least 100 household surveyed), and (2) capacity to identify and respond to disease outbreak at 8 local health centres. Interviews and questionnaires to be conducted with the same participants as Y1. Reports shared with partners every 3 months, final report by March Y4

2.1 IBAP and UoE to train IBAP DPO and eight DFOs in data collection (8 DFOs: wildlife survey, primate fecal sampling; DPO: data management and analysis, report writing)

2.2 UoE and IBAP DPO to establish survey areas (transects and camera trap sites)

2.3 IBAP and UoE to coordinate monitoring programme. 8 DFOs to walk transects across all major forest blocks to collect survey data for primates, set up and maintain camera traps, collect faecal samples. Camera traps will be set up systematically (at least 60 independent sampling points, covering different habitat types) for 2 months during the dry season each year. Transect surveys and faecal sampling will be conducted in both dry and rainy seasons.

2.4 IBAP DPO to monitor progress of wildlife monitoring programme via data entry and meetings with DFOs and UoE. Data and report shared with project partners every 3 months

2.5 IBAP DPO to transport faecal samples to Bissau every 2 months (to be stored at IBAP). RKI to organise shipping and import permits, IBAP to ship faecal samples to RKI (Germany) every 6 months. RKI to analyse samples and send project partners the results every 3 months

2.6 IBAP DPO and DRF to evaluate programme via data analysis (i.e. obtain indices of abundance, map primate distribution and leprosy occurrence). Report write up and share with project partners every 6 months. UoE to conduct land classification analysis of Y1 and Y3 satellite imagery (end of Y3)

2.7 UoE and IBAP to finalise wildlife monitoring protocol (including detailed procedures for data collection, data entry, data management and analysis) to be incorporated by IBAP in long-term management plan for Cantanhez NP (By end of Y3)

3.1 UoE to analyse spatial data and create human-wildlife interaction hotspot maps of the whole Cantanhez NP, based on Y1 and Y2 wildlife monitoring programme data (wildlife survey and faecal sample data) and human social data (risk behaviour)

3.2 UoE and RKI write up results and disseminate to project partners

3.3 UoE and IBAP to meet with local communities to present and discuss human-wildlife interaction maps

3.4 Local community representatives (incl. Women's Associations, regional chieftains, health workers) and all project partners participate in workshop to develop a human-wildlife interaction plan that focuses on management of high risk areas (according to disease prevalence, land use, human behaviour, high human-primate spatial overlap)

3.5 UoE to draft of human-wildlife interaction plan including maps and workshop proceedings and share with local communities and project partners

3.6 UoE and IBAP to finalise multi-stakeholder human-wildlife interaction plan and share with local communities and project partners

4.1 Opening meeting with project partners and stakeholders. Present project objectives and timeline, establish roles and responsibilities. Meeting proceedings written up and distributed to project partners

4.2 Project partners to meet for annual M&E

4.3 All project partners to identify and engage with relevant organisation focal points (incl. Ministry of Health, hospitals in Bissau and WHO) for inclusion in the response strategy

4.4 Project partners to hold workshop to develop long-term disease readiness and conflict mitigation strategy (in collaboration with local stakeholders, incl. Nalu chieftains, Women's Associations, health workers, and focal points of relevant organisations, incl. WHO, hospitals in Bissau, Ministry of Health)

4.5 Project partners to write response strategy to be approved by key organisations and local stakeholders. UoE and IBAP to write up conflict mitigation and response strategy. NADEL and other key health organisations to write up disease outbreak response strategy

4.6 NADEL DPO and IBAP DPO to monitor and evaluate the conservation/disease related strategies via meetings and reports every 3 months

## Annex 2.1: Revised Logframe

| Project summary | Measurable Indicators | Means of verification | Important Assumptions |
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| **Impact:**<br>Improved public health through increased resilience to infectious disease outbreaks in local communities, with improved capacity to manage threatened biodiversity and human-wildlife interactions, at Cantanhez National Park, Guinea-Bissau. | | | |
| **Outcome:**<br>Improved knowledge and surveillance of leprosy in wildlife and humans, with enhanced capacity to manage human-wildlife interactions and support conservation and human health at Cantanhez NP. | **0.1** By end of project, leprosy in humans and nonhuman primates is integrated into One Health strategies, and an evidence-based One Health campaign strategy is developed for Cantanhez NP.<br><br>**0.2** By end of project, institutional capacity to monitor disease in wildlife in Cantanhez NP is increased to 80% compared to baseline (zero) through the implementation of biodiversity monitoring and the establishment of an IBAP surveillance team for sample collection and management of animal carcasses.<br><br>**0.3** By end of project, human-wildlife interactions related to One Health risks are incorporated into management strategies for Cantanhez NP, and at least 30% of IBAP's technical team have attended training in monitoring forest changes in protected forest blocks using remote sensing and GIS.<br><br>**0.4** By end of project, improved coordination between health and conservation stakeholders have enhanced institutional capacity to respond to zoonotic disease and disease-related conservation conflicts. | **0.1** Up-to-date data on leprosy in wildlife and humans. One Health campaign trial strategy and implemented in partner villages (N=6) with at least 60 people (at least 50% women) involved. Pre- and post- One Health campaign trial data collection and analysis. One Health campaign strategy report written up and shared with project partners.<br><br>**0.2** Biodiversity monitoring (transects and camera traps, faecal samples) implemented and protocol including sampling design, details of methods and analyses, is written up. An IBAP surveillance team (at least four technicians, including the Director of Cantanhez) is trained in carcass swabbing and disposal (Y3). IBAP's 8 DFOs and local collaborators are trained in carcass surveillance and communication chain established by the end of Y3.<br><br>**0.3** Human-wildlife hotspots identified (based on analyses of biodiversity monitoring and participatory mapping data). Meetings with local stakeholders (local management committee, women's groups, farmers, hunters) and IBAP. One Health environmental management plan written by UoE and | *Anonymous data shared for all patients and records kept appropriately by health workers.*<br><br>*Stakeholders, including partners and key local collaborators such as the Womens Association, remain engaged and committed to improve public health throughout the project.*<br><br>*Stakeholders, including partners and key local collaborators such as the Women's Associations, remain engaged in project activities, including developing health and conservation strategic plans.*<br><br>*Country remains politically stable (since its inception IBAP has remained unaffected by political instability and our research team has experienced no problems working in Cantanhez NP).*<br><br>*The COVID-19 pandemic does not worsen to such levels in the United Kingdom and Guinea-Bissau that we cannot continue with any of our revised activities.* |

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| | | IBAP. Number of people trained in remote sensing and GIS.<br><br>**0.4** Analysis of camera trap and faecal sampling data from the biodiversity monitoring programme. Review of primary records and Ministry of Health and NGO reports (for up-to-date leprosy status in Guinea-Bissau, existing strategies including One Health and leprosy-specific). Literature review of conservation conflicts over disease. Integration of latest information on leprosy in wildlife. Multi-stakeholder meetings (project partners, Cumura Hospital, AIFO, WHO representatives). Number of meetings and list of participants. Multi-stakeholder leprosy response plan written up and shared with stakeholders. | |
| **Output 1**<br><br>Surveillance for leprosy disease in Cantanhez is increased and partner villages demonstrate improvement in understanding the links between environmental, animal and human health. | **1.1** By the end of Y2, understanding of local knowledge and perceptions of disease is improved by at least 15% compared to baseline 5% (based on previous literature from Cantanhez NP) and potential risk factors for wildlife-to-humans disease transmissions are identified.<br><br>**1.2** By the middle of Y3, at least 80% of local nurses (N=6), health agents (N=50) and traditional healers (N=10) are trained to identify early symptoms of leprosy disease.<br><br>**1.3** By the end of Y3, at least 50% of campaign participants (N=30 out of 60, including at least 50% women) demonstrate increased understanding in the links between environmental, animal and human health via One Health trial campaign in six partner | **1.1** Questionnaire data collection by NADEL DPO with 100 households across at least 25 out of 165 villages. Literature review and collation of Cantanhez Chimpanzee Project data.<br><br>**1.2** Training and number of trainees from each professional group (nurse, health agents, healers). Pre- and post-training data collection.<br><br>**1.3** Interviews pre- and post-campaign with 60 One Health trial campaign participants. *We have selected six partner villages to trial our One Health campaign to ensure effective messaging for future park-wide roll out. Partner villages consist of villages neighbouring chimpanzee communities with confirmed cases of leprosy. The main messages of the One Health campaign consist of the links between | *Local communities are willing to dedicate time and engage in activities throughout the duration of this project.*<br><br>Risks of leprosy-related retaliatory behaviour towards wildlife are reduced by increasing the public's knowledge about zoonotic disease (including information about transmission risks, mitigation strategies associated with human behaviour, leprosy disease life cycle, health care provision by the local and regional health institutions).<br><br>The presence of leprosy in chimpanzees at Cantanhez is not discussed with and sensationalised by the media (to avoid this, we have a signed confidentiality agreement between IBAP, NADEL and researchers). |

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| | villages compared to baseline pre-campaign. | environmental, animal and human health with example of leprosy as disease that can occur in both humans and animals and be transmitted from humans to animals | |
| **Output 2**<br><br>Improved wildlife management capacity through the establishment of the **first health and abundance systematic monitoring programme** for key terrestrial biodiversity in Guinea-Bissau. | **2.1** By Y2, the wildlife monitoring capacity in Cantanhez NP is increased to 80% compared to baseline 5% (based on number of park staff trained to record and analyse data, and existing training manuals).<br><br>**2.2** By the end of Y3, regular monitoring has improved knowledge of biodiversity and disease presence across Cantanhez NP, including 12 protected forest blocks (approximately 70km$^2$) compared to pre-project baseline 20% (including pilot data collected in 2018 - Halpin Urgency Grant and PhD data by DRF collected in 2016-2017).<br><br>**2.3** By the end of Y3, institutional capacity to sample, handle and dispose wild animal carcasses securely is increased by 100% compared to baseline zero.<br><br>**2.4** By the beginning of Y4, the biodiversity monitoring programme is evaluated and incorporated into IBAP's long-term management of Cantanhez NP. | **2.1** Training sessions with IBAP DPOs and DFOs. Eight DFOs and two DPOs collect data. Two DPOs enter, manage and summarise survey data. Number of training manuals produced and shared with IBAP. Reports shared with DRF every 6 months.<br><br>**2.2** Data collection, analysis and report written up. Samples analysed for presence/absence of leprosy and results written up.<br><br>**2.3** Number of IBAP technicians trained by UoE and RKI. Carcass swabbing and disposal protocol developed and shared with IBAP.<br><br>**2.4** Biodiversity monitoring programme protocol finalised and validated by IBAP. | Partner organisation staff (IBAP) continue to be employed during and beyond the completion of this project (and find substitutes if necessary).<br><br>Please note: In this project we do not cover wildlife treatment costs. Chimpanzees and other primates have intentionally not been habituated to researcher presence, making the darting and treatment of infected individuals extremely complicated, costly and ethically questionable. |
| **Output 3**<br><br>A **One Health environmental management plan** to promote healthy human-wildlife coexistence and | **3.1** By the middle of Y3, key wildlife habitat including corridors, and areas of high human-wildlife interaction and potential disease transmission are identified. | **3.1** Production of human-wildlife interaction hotspot maps and report. Map layers include park-wise maps of intensity of space use by key taxa (primates, ungulates), human land uses (villages, roads, agriculture), 2017-2021 | Partners and local stakeholders remain committed to engage in project meetings and workshop.<br><br>Consensus is achieved for the plan. |

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| strengthen multi-stakeholder decision-making capacity in Cantanhez NP. | **3.2** By the end of Y3, the plan is developed with stakeholders (Management Committee and other group representatives including from the Cantanhez Women's Associations) comprising at least 50% women.<br><br>**3.3** By the beginning of Y4, the plan is written up by project partners and agreed by IBAP and local communities. | satellite imagery of vegetation cover (converted to NDVI) and forest blocks (TRUE COLOR), health landmarks (graded health centres, health agents, healers), as well as risk landmarks (incl. water and food sources shared between people and wildlife) at six partner villages.<br><br>**3.2** Pre-plan meetings with local stakeholders to discuss plan vision and gather ideas. Report shared with partners. Workshop delivered (N of attendees and group representatives). Workshop proceedings shared with partners and stakeholders.<br><br>**3.3** Plan signed by IBAP and local community representatives at Cantanhez NP. | No unresolvable conflict occurs between local communities and partners during the course of this project. |
| **Output 4**<br>Increased long-term readiness for potential public zoonotic threats and disease-related conflicts through the development of a **multi-stakeholder leprosy response plan** for Cantanhez NP. | **4.1** By Y2, key health organisation focal points are identified. By the beginning of Y3, regular communication and collaboration between health and conservation organisations is established.<br><br>**4.2** By the middle of Y3, multi-stakeholder knowledge of leprosy occurrence in humans and wildlife is improved via up-to-date case mapping.<br><br>**4.3** By Y4, institutional knowledge to manage and respond to conflicts over leprosy disease (including mistrust of health services, retaliatory behaviour towards animals) and leprosy in humans is increased via the production of the first multi-stakeholder leprosy response plan in Guinea-Bissau. | **4.1** Number of meetings with stakeholders (one every four months in Y3) and regular meetings between project partners (every two months). Monthly contact via emails and WhatsApp, including project updates and information sharing between all stakeholders.<br><br>**4.2** Literature review and consultation with leprosy specialists in Guinea-Bissau. Biodiversity monitoring data on leprosy cases in wildlife. GIS mapping. Report shared with health stakeholders and project partners.<br><br>**4.3** Literature review of conservation conflicts over disease. Series of meetings with conservation and health stakeholders carried out in Y3Q3. Stakeholders include project partners and key health organisation identified in | Stakeholders recognise the long-term importance of the strategy and remain committed throughout and beyond the completion of this project.<br><br>Roles and responsibilities in mitigation strategies and response to emergencies are fully accepted and recognised by partners and stakeholders.<br><br>Stakeholders take responsibility to find substitutes if necessary.<br><br>Please note: In this project we do not cover human medical treatment costs. When developing the long-term response strategy we will identify funding for treatment costs, as was done previously (in collaboration with NADEL) during a recent cholera |

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| | | Y1-2 (including Cumura, WHO, AIFO). List of participants and organisations attending meetings. Conflict-response strategic plan written up and included in the leprosy and conservation strategic plan. Literature review of existing outbreak response strategies, One Health and WHO policies and current institutional arrangements in Guinea-Bissau by Y3Q3. Sources of financial aid to cover human medical treatment for leprosy identified (e.g. Ministry of Health Guinea-Bissau, WHO). Leprosy case communication chain (from health agent/healer to Cumura Hospital and WHO) established. Health and conservation strategic plan drafted and shared with stakeholders' focal points by Y3Q4. Strategic plan finalised and shared with stakeholder organisations by Y4Q1. | outbreak. WHO offer free leprosy treatment. |

**Activities**

**Output 1**

**1.1** NADEL, CRIA and UoE DRF to train NADEL DPO in pre-campaign data collection, entry, and analysis. [Y1, Y2, Y3]

**1.2** NADEL DPO to collect questionnaire data to assess local knowledge and perceptions of infectious diseases, use of health services, and identify potential animal-to-human disease transmission risk factors. at least 100 participants interviewed. Data analysis by CRIA. [exploratory survey in Y1Q3, data collected by Y2Q3]

**1.3** Pre-training data collection. NADEL DPO to assess capacity of local health force to identify leprosy disease at early- and advanced-stage. Report shared with project partners. [Y1Q4, Y3Q1-2]

**1.4** Data analysis by NADEL DPO, CRIA and UoE. [Y1Q4 - Y3Q4]

**1.5** Review of One Health campaigns previously carried out (including strategy, communication material, messages) to adapt for our pilot campaign. [Y2Q4-Y3Q1]

**1.6** Develop One Health campaign trial: Series of meetings between project partners in Y2Q4-Y3Q1. One Health campaign document, including background information, campaign messages and communication strategy is written up by project partners using social science research data and review of One Health campaigns. [Y3Q2]

**1.7** Campaign messages submitted for approval to the Centro de Informação Comunicação para a Saúde (CICS) and the Instituto Nacional Saúde Pública (INASA). [Y3Q2]

**1.8** Pre- One Health campaign trial data collection with at least 60 participants (>50% women) using questionnaires. [Y3Q2-3]

**1.9** Clinical training to local nurses, health agents and traditional healers to identify leprosy and referral protocol by Cumura, AIFO and NADEL. [Y3Q2-3]

**1.10** Training to One Health campaign personnel (DPO, DFOs) by UoE, Cumura, NADEL. [Y3Q3]

**1.11** Pilot One Health campaign in six villages. NADEL DPO to coordinate campaign activities with the support of six Health DFOs. [Y3Q3]

**1.12** Evaluation: Post-training data collection to evaluate training to nurses, health agents and traditional healers. One Health campaign evaluation (post-campaign questionnaires). Data analysis by NADEL DPO and CRIA. [Y3Q4]

**1.13** Full report written up and shared with project partners and health stakeholders. [Y4]

**Output 2**

**2.1** IBAP and UoE to train two IBAP DPOs and eight DFOs in data collection (8 DFOs: wildlife survey, primate faecal sampling; DPO: data management and analysis, report writing). [Y1Q3-4, with refreshment trainings throughout Y2 and Y3]

**2.2** UoE and IBAP DPOs to establish survey sampling sites (transects and camera trap sites) with DFOs. [Y1Q3, revised in Y1Q4]

**2.3** IBAP and UoE to coordinate monitoring programme. Eight DFOs to walk transects and set up and maintain camera traps across Cantanhez NP, including within at least 12 forest blocks. Camera traps to be set up systematically (at least 40 independent sampling points, covering different habitat types) for at least 4 months during the dry season each year (totalling at least 4800 camera trap days). Transect surveys across Cantanhez NP to be conducted in the dry season (December-June). DFOs to repeat transects once per month, totalling at least 200km of survey effort in Season 1 (Y1/Y2) and 300km of survey effort in subsequent Seasons. DFOs to collect habitat type data every 100m along transects. [Y1Q4-Y4]

**2.4** IBAP DPOs to monitor progress of wildlife monitoring programme via data entry and meetings with DFOs and UoE. Data shared with UoE DRF every two months. Report by IBAP DPOs shared with UoE every six months. [Y1Q4-Y4]

**2.5** Intensive leprosy monitoring training: UoE and RKI to finalise faecal sampling data collection protocol. UoE to train two IBAP DPOs in faecal sample collection, handling, and storage. IBAP to select six local collaborators. IBAP DPOs to train two local Research Consultants (RCs) and six collaborators in sampling protocol (faecal sampling and camera trap deployment strategy). [Y2Q4-Y3Q1]

**2.6** Intensive leprosy monitoring: IBAP DPOs, two local Research Consultants (RCs) and six local collaborators to (1) deploy and maintain 60 camera traps for targeted leprosy surveillance across chimpanzee communities where leprosy has been identified, and (2) collect faecal samples for PCR leprosy screening and DNA profiles (two tubes per sample). DPOs to process and store faecal samples securely and manage camera trap data. [Y3Q1-Y3Q4]

**2.7** UoE and RKI to conduct analyses of faecal samples. Report shared with project partners. [Y3Q3-Y3Q4]

**2.8** Evaluation (data analysis): IBAP DPO and UoE DRF to evaluate programme via data analysis (i.e. obtain indices of abundance, map primate distribution and leprosy occurrence). Report shared with partners every six months. [Y2Q1-Y4]

**2.9** Establishing surveillance team for carcass swabbing and management: RKI and UoE to finalise carcass swabbing protocol. IBAP to select surveillance team. RKI and UoE to train surveillance team (at least four IBAP technicians, including Cantanhez NP Director) in carcass swabbing, handling and disposal, data collection and database management. IBAP and UoE to train eight DFOs and local collaborators across Cantanhez NP in case reporting (communication chain) and management (including to avoid touching carcass and inform residents about safety measures) and data collection protocol. [Y3Q3]

**2.10** Develop long term protocol: UoE and IBAP to finalise wildlife monitoring protocol (including detailed procedures for data collection, data entry, data management and analysis) to be incorporated by IBAP in long-term management plan for Cantanhez NP [by end of Y3]

**Output 3**

**3.1** Analysis of BMP Season 1 data, including Bayesian-INLA spatial models of primates and ungulates using covariates generated via remote sensing (including NDVI, distance to villages, forest blocks, roads). [Y3Q1]

**3.2** Six Health DFOs selected and trained in participatory mapping data collection. [Y3Q1-2]

**3.3** Six Health DFOs to conduct participatory mapping of risk sites across six village areas, including collecting data on water sources and food resources shared with wildlife (e.g. cultivated fruit sites with signs of wildlife use, freshwater streams used for bathing, washing and/or obtaining water). [Y3Q1-Y3Q4]

**3.4** Meetings with the management committee* as well as women's associations, farmers and hunters of partner villages to discuss plan vision. UoE DRF and IBAP Director to show wildlife distribution maps (from spatial analysis) and discuss with stakeholders sympatry and spatial overlap, gather ideas for potential ways to mitigate health risks (e.g., avoid direct encounters with chimpanzees, planting certain crop foods away from villages, wash fruit, use separate water sources). *the management committee consists of village representatives involved in park management with IBAP. [Y3Q2-3]

**3.5** Meetings' proceedings written up and shared with project partners. [Y3Q2-3]

**3.6** Data analysis by UoE DRF (participatory mapping, remote sensing). Participatory data integrated with spatial model output maps. Report written up and shared with project partners. [Y3Q3]

**3.7** Workshop to develop One Health environmental management plan. Local community representatives (incl. Women's Associations, regional chieftains, health workers) and all project partners participate in workshop to develop a One Health environmental management plan that takes into account human-wildlife interactions with focus on management of high-risk areas (according to disease prevalence, land use, high human-primate spatial overlap, risk landmarks obtained using participatory mapping). [Y3Q3]

**3.8** UoE and IBAP to draft One Health environmental management plan including maps and workshop proceedings. [Y3Q3]

**3.9** IBAP and UoE to discuss draft with local stakeholders (workshop participants) and share report with project partners. [Y3Q4]

**3.10** Plan document finalised by project partners (UoE, IBAP, CRIA). [Y3Q4]

**3.11** UoE DRF to conduct training to IBAP technician on GIS data manipulation (access, download and process Sentinel-2 images, including for NDVI and forest monitoring). Step-by-step guide shared with IBAP [Y4Q1]

**3.12** Plan approved by IBAP and local stakeholders (management committee, women's groups, farmers, hunters). [Y4Q1]

**Output 4**

**4.1** Opening meeting with project partners and stakeholders. Present project objectives and timeline, establish roles and responsibilities. Meeting proceedings written up and distributed to project partners. [Y1Q2]

**4.2** Project partners to meet for annual M&E [Y1Q4 Bissau, Y2Q4 Zoom, Y3 Lisbon].

**4.3** All project partners to identify and engage with relevant organisation focal points (incl. Ministry of Health, hospitals in Bissau and WHO) for inclusion in the response strategy. [Y2]

**4.4** Meetings every four months with conservation and health stakeholders (project partners and Cumura, AIFO and WHO). [Y3]

**4.5** Up-to-date leprosy case GIS mapping based on patient records at Cumura Hospital. [Y3Q2]

**4.6** Literature review and grey literature data gathering by NADEL DPO: overview of situation of leprosy in humans in Guinea-Bissau, leprosy strategies (National and global strategies, WHO strategy and guidelines), health system in Guinea-Bissau and leprosy trainings at different levels within the national health system, case

management at Cumura Hospital, past health campaigns and response strategies in Cantanhez NP and Guinea-Bissau. Report shared with project partners and health stakeholders. [Y3]

**4.7** Review of communication chain for leprosy case detection and management in humans (from village to referential hospital, and reports to WHO). Report shared with project partners and health stakeholders. [Y3]

**4.8** Literature review on conservation conflicts over disease in tropical regions. Report shared with project partners and health stakeholders. [Y3]

**4.9** Meetings with conservation and health stakeholders (project partners and Cumura, AIFO, WHO) to develop conservation conflict response strategy. [Y3Q3]

**4.10** NADEL DPO, UoE and IBAP draft strategic plan and share with CRIA, RKI and health stakeholders (Cumura, AIFO, WHO). [Y3Q3-4]

**4.11** Multi-stakeholder leprosy response plan finalised by project partners and health stakeholders. Plan shared with key organisations (WHO, Ministry of Health). [Y4]

# Annex 3: Standard Measures

**Table 1 Project Standard Output Measures**

| Code No. | Description | Gender of people (if relevant) | Nationality of people (if relevant) | Year 1 Total | Year 2 Total | Year 3 Total | Total to date | Total planned during the project |
|---|---|---|---|---|---|---|---|---|
| Established codes | | | | | | | | |
| 6A | Wildlife survey data collection incl. using GPS, SMART-Cybertracker | Women (1), Men (11) | Bissau-Guinean | 4 weeks | 2 | 2 | 6 | 8 |
| 6A | Faecal sampling data collection | Women (2), Men (8) | Bissau-Guinean | 0 | 1 | 2 | 1 | 3 |
| 6A | Faecal sampling management and storage | Women (1), Men (1) | Bissau-Guinean | 0 | 1 | 2 | 1 | 3 |
| 6A | Data entry and management in BaseCamp and SMART | Women (1) and men (1) | Bissau-Guinean | 2 weeks | 2 | | 4 | 4 |
| 6A | Participatory mapping training | | Bissau-Guinean | 0 | 0 | 2 | 0 | 2 |
| 7 | Data Collection Manuals: Camera trap, GPS, Distance Sampling info sheet, Cybertracker, SMART manuals, Guard health protocol, faecal sampling | | Written in Bissau-Guinean Creole | 6 | 2 | Revision | 8 | 10 |
| 10 | Biodiversity monitoring protocol | | Written in EN and PT | (v. 1) | (v. 2) | 1 final | | 1 |

## Table 2 Publications

| Title | Type (e.g. journals, manual, CDs) | Detail (authors, year) | Gender of Lead Author | Nationality of Lead Author | Publishers (name, city) | Available from (e.g. weblink or publisher if not available online) |
|---|---|---|---|---|---|---|
| Ch mpanzees ba ance resources and r sk n an anthropogen c andscape of fear | Journa | Bersaco a E, H CM, Hock ngs KJ. | Fema e | Sw ss | Sc ent f c Reports | do .org/10.1038/s41598 021 83852 3<br><br>https://www.nature.com/articles/s41598-021-83852-3 |
| Leprosy n Ch mpanzees. | Prepr nt (current undergo n g rev s ons n *Nature*) | KJ Hock ngs B Mubemba, C Avanz , K P eh, A Düx, E Bersaco a, J Bessa, M Ramon, S Metzger, L Patrono, J. Jaffe, A Benjak, C Bonneaud, P Busso, E Couacy Hymann, M Gado, S Gagneux, R. Johnson, M Kod o, J Lynton Jenk ns, I Morozova, K Mätz Rens ng, A Rega a, A Sa d, V Schuenema nn, S Sow, J Spencer, M U r ch, H Zoub , S Co e, R W tt g, S Ca v gnac Spencer, F Leendertz. | Fema e | UK (w th 8 Afr can nat ona s as co authors) | B oRx v | do .org/10.1101/2020.11.10.374371 |
| F rst ev dence of ch mpanzee extract ve too use n Cantanhez, Gu nea B ssau: Cross commun ty var at on n honey d pp ng | Journa Art c e | Bessa J, Hock ngs KJ, B ro D, | fema e | Portuga | Front ers n Eco ogy and Evo ut on | do : 10.3389/fevo.2021.625303 |

## Checklist for submission

| | Check |
|---|---|
| **Is the report less than 10MB?** If so, please email to Darwin-Projects@ltsi.co.uk putting the project number in the Subject line. | Y |
| **Is your report more than 10MB?** If so, please discuss with Darwin-Projects@ltsi.co.uk about the best way to deliver the report, putting the project number in the Subject line. | N |
| **Have you included means of verification?** You should not submit every project document, but the main outputs and a selection of the others would strengthen the report. | Y |
| **Do you have hard copies of material you need to submit with the report?** If so, please make this clear in the covering email and ensure all material is marked with the project number. However, we would expect that most material will now be electronic. | N |
| Have you involved your partners in preparation of the report and named the main contributors | Y |
| Have you completed the Project Expenditure table fully? | Y |
| Do not include claim forms or other communications with this report. | |