African wild dog dispersal and demography study

University of Zurich | Winterthurerstrasse 190 | CH – 8057 Zürich
Botswana Predator Conservation | Maun | Botswana

Yearly Research Report
1.1.2022 – 31.12.2022

Prepared by

Gabriele Cozzi
gabriele.cozzi@uzh.ch | gab.cozzi@gmail.com

This report is available online at (page bottom):
https://www.popecol.org/research/african-wild-dog-dispersal-and-demography/

CONTENTS

1. PROJECT OVERVIEW AND AIM

This project is a collaborative effort between the Population Ecology Research Group of the University of Zurich (www.popecol.org) and the Botswana Predator Conservation (BPC, www.bpctrust.org), The aim of the project is to follow dispersers after emigration from the natal group and to i) investigate the effect of landscape characteristics on dispersal distance, time, movement patterns and habitat selection, ii) assess dispersal corridors and connectivity across larger landscapes,ii) gather crucial demographic parameters such as mortality rate, settlement success, reproductive success after settlement in a new territory iv) combine this novel information on dispersing individuals with long-term demographic information on resident groups collected by the BPC over the past 25 years to produce population viability models under changing environmental and anthropogenic scenarios.

Understanding mechanism and patterns of wild dog dispersal, and its demographic consequences is fundamental for the management and conservation of the species nationally, but also across the broader landscapes of Southern Africa such as the Kavango Zambezi Transfrontier Conservation Area (KAZA/TCA). We aim to provide scientific information and advice to policy makers, resource managers, stakeholders, scientists, and the general public.

Results and knowledge generated from this research will help predict population changes under changing scenarios and thus be crucial towards the management and conservation of free-living populations of the African wild dog.

2. FIELD ACTIVITIES

2.1. DISPERSAL MOVEMENTS

During 2022 we were able to resume normal field activities, which in previous years were much reduced due to the COVID-19 pandemics and the consequent lockdowns. For the first time since beginning of the project, during 2021 we did not record any long-distance dispersal trajectories. With one exception, all recorded dispersal events where within the historic range monitored by the BPC, which comprises Moremi Game Reserve (NG28), NG31, 32, 33, 34. This was likely both the cause and the result of a very dynamic situation among the resident packs.

On one side, we observed packs dissolving due to natural death of old founder and dominant individuals; on the other side, we watched dispersing coalitions leaving their natal pack and aggressively taking over adjacent packs. Both processes destabilize the dynamic of the resident packs and result in several satellites, unstable and unsettled sub-groups across the entire study area.

Only one dispersing coalition, composed of two males, left the historic BPC study area (Figure 1) and moved south of the Southern Buffalo fence. Exactly one month after they crossed the fence and started moving across the communal land the collared animal was found dead. Despite the carcass was located three days after the dog had died (the collar sends a mortality signal) and the exact of cause of death could not be confirmed, because the body was found a couple hundred meters from a human outpost, we take for granted that the dog has died of human-related causes (either shooting or poisoning). The site of death was roughly 15 km east of the outskirt of Maun and 35 km south of the Buffalo Fence. This case adds to the growing evidence of a severe lack of successful dispersal events from the Okavango Delta ecosystem to the Central Kalahari ecosystem south of thee A3 highway Gweta-Maun-Toteng, and how such lack is human related. Dispersing wild dogs either die to human actions or are repelled back to the Okavango ecosystem as they move to human and human activities alog the A3. Since project begin in 2016, we only recorded one dispersal coalition to successfully cross the A3 and settle between the A3 and Xhumaga (cfr. yearly report 2021).

As of 31.12.2022, we are GPS monitoring eight (8) dispersing individuals/coalitions, which are expected to disperse in the near future. The collars used in this study (Vertex Lite, Vectronic Aerospace, Berlin) automatically record precise GPS positions several times each day and regularly send them to a base station through the Iridium satellite system. This technology allows to remotely follow the movements of collared individuals even in inaccessible places.

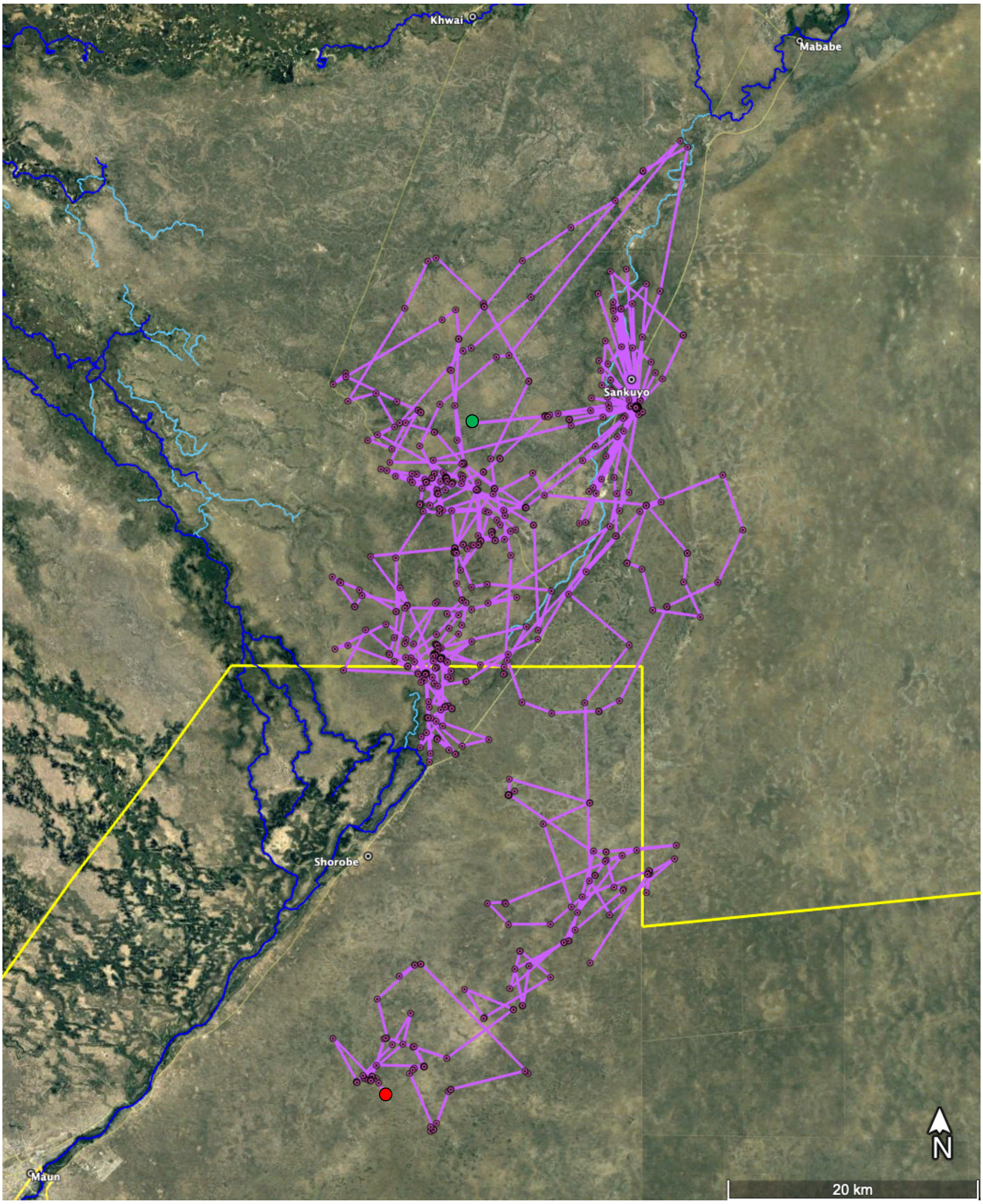

Figure 1:Movement trajectory (purple) of the only long-distance dispersal event recorded during 2022. Green dot: collaring site; red dot: death site; yellow line: Southern Buffalo Fence; dark and pale blue lines: permanent and ephemeral rivers.

2.2. CAMERA TRAPPING

During October and November 2021, we placed 56 camera traps for our long-term monitoring program. The reason for using camera traps is to monitor the distribution, abundance, and habitat use of prey and carnivore species to better understand the dispersal mechanisms and dispersal routes of young African wild dogs that emigrate from their natal packs. Prey species are expected to have a positive influence on the movement trajectories and success of dispersal events, while other carnivores, such as for example lions, are expected to have a negative influence on dispersal. Contrarily to other camera trapping projects conducted in the past and that are a short snapshot in time (e.g., a few months only), these camera traps will be deployed during the entire year and for several years. This setup will allow us to investigate seasonal trends (e.g., differences between dry and wet season) and trends over several years. We placed the cameras on a 4x4 km^2 squared grid, and equally sampled across the three major habitat types: mopane woodland, mixed shrubs acacia dominated, floodplains/grasslands (Figure 2). The camera traps use an infra-red flash and so are not visible at night and do not disturb animals and touristic activities (Figure 3).

During 2022, we obtained > 2 Mio pictures, collected mainly between 08:00 – 17:00 (Figure 4). We processed the images recorded by the camera traps using an open-source artificial intelligence-based algorithm (Megadetector) that categorizes each image as (i) containing an animal, (ii) containing a person, (iii) containing a vehicle, (iv) containing vegetation only (later referred to as ghost images). The Megadetector works both on color and black and white pictures. Ghost images represented about 75% of all collected pictures. Images containing people and vehicles were not retained due to privacy reasons. After excluding ghost images, pictures with animals represented about 75% of all remaining images (~0.8 Mio images). Pictures were almost equally distributed across the three main habitat types (Figure 4). About 75% of the images did not contain any detectable object (later referred to as ghost images), and the cameras were likely triggered by moving grass or branches. This ghost images occurred most frequently around the midday hours in each of the three habitat types (Figure 4).

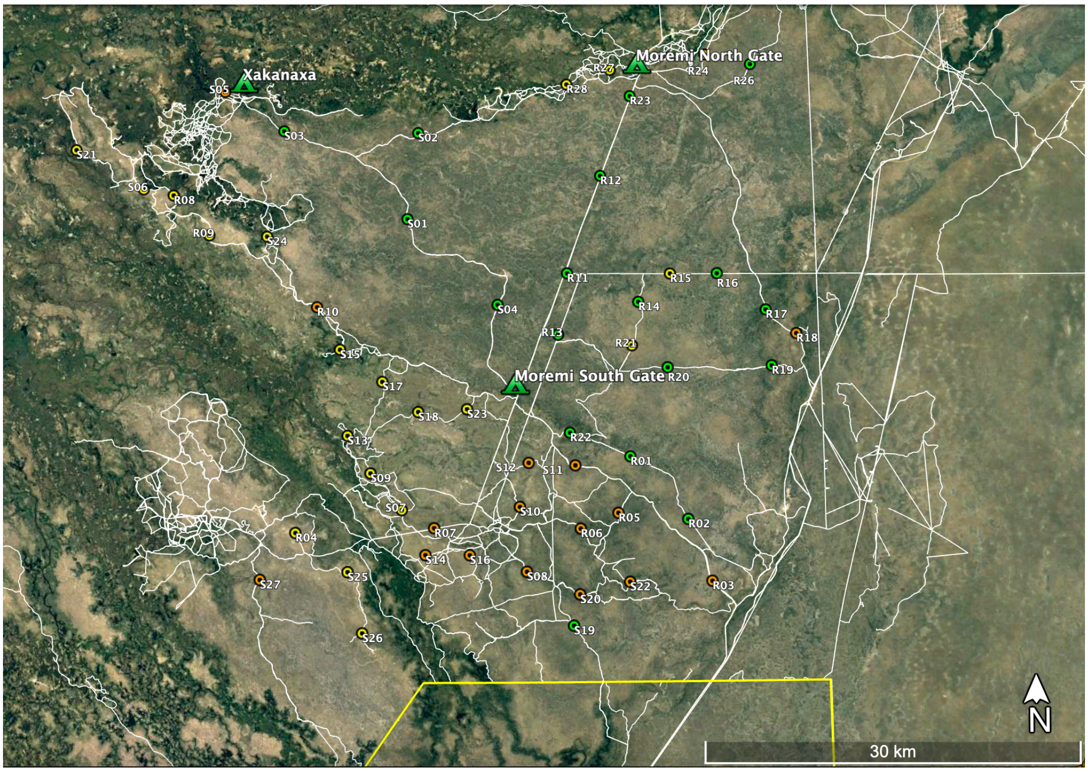

Figure 2: Camera trap survey setup north of the Southern Buffalo Fence (yellow line). Fifty-six cameras equally distributed across three main habitat types (green = mopane forest, yellow = grassland/floodplain, orange = mixed woodland acacia dominated) have been laid on a roughly 4x4 km² grid, and according to the road system (white lines). The cameras are part of a long-term monitoring plan aiming at gathering information on (i) seasonal patterns in habitat use and distribution and (ii) long-term trends in populations abundances. Information will be gathered both on large carnivores (the main competitors of African wild dogs) and herbivores (the main prey of African wild dogs). The study area (ca. 2'500 km²) covers the southeastern section of Moremi Game Reserve (NG28), NG31, 32, 33, 34.

Figure 3: Some example images taken from the camera-traps setup across our study area in northern Botswana. Cameras record color pictures during daytime and black and white pictures at night. No white flash is used at night to ensure animals and tourist are not disturbed

Figure 4: Total number of images by hour (top left panel); Total number of images by habitat type (top right panel); Hourly distribution of ghost images per habitat type (bottom left panel); Hourly relative frequency of detection of animals, people, or vehicles (bottom right panel).

During 2023, we will continue to collect images through our camera traps, and at the same time, we will analyze the images collected during 2022. We will take advantage of the freely available software "TrapTagger" to assign a species ID to each picture with animals as identified using the Megadetector. We aim to understand pattens of habitat use and abundance for selected focal species such as impala, kudu, steenbok, and warthogs (the main prey of African wild dogs) and lions and spotted hyenas (the main wild dog competitors). The analytical task will be offered as a MSc project to be conducted at University of Zurich.

2.3. CITIZEN SCIENCE

Over the past years, we have been active linking and networking with the tourism industry (i.e. tour operators and self-drivers). The main aim of this initiative is to obtain information about wild dog presence across the entire ecosystem and expand such knowledge nationally and internationally across KAZA. This initiative is also known as "Wanted_Initiative" and the name stems from the posters (Figure 5) and leaflets that we have distributed to increase the flow of information that tourists send us. Through pictures, we aim to obtain information on:

- Long-distance and transboundary dispersal events
- Survival and reproductive success of resident and dispersing individuals
- Abundance estimates for the entire ecosystem.

During 2022 we made good progress in curating and matching some of the pictures received over the past years. At present we have been able to collect information from > 750 sightings. We have so far been able to process and upload 423 sightings into the artificial intelligence based African Carnivores Wildbook platform (https://africancarnivore.wildbook.org), which helps identifying and matching single individuals. Altogether, the 423 sightings contain 6913 pictures and 17431 wild dog encounters. An encounter is defined as a single wild dog within a given picture. The number of encounters is higher than the number of pictures since it is very common that there are several individuals in a single frame. So far, we have matched individual wild dogs from 114 sightings and were able to identify 723 different individuals. However, please note that this figure is across several years and therefore not necessarily representative. Additionally, this number suffers from the fact that, at present we do not have the possibility of automatically match left and right side of the same individual, therefore individuals that are here considered as two separate animals may indeed be the same one. Refining the number of single individuals as we go through more pictures will allow us to obtain a minimal estimate of the individual wild dogs inhabiting the ecosystem.

We believe the "Wanted_Inititive" has a great potential and we will be able to assess its full potential as soon as we will terminate matching all pictures from the > 750 sightings we already have obtained from tourists. Below are two examples of the type of information we are obtaining through this important citizen science initiative. From the examples, it appears evident, that pictures allow following the fate of dispersing individuals over long distance of several hundred kilometres, across international borders, and assessing survival of individuals that disappear from the main study population:

Figure 5: A tourist taking a picture of the "Wanted" poster placed at Maun airport. Through the poster QR-code, tourists are directed to a webpage with comprehensive information about the project.

Example 1:

Pictures of African wild dogs taken by a tourist on 2018-10-20 at coordinates 25.23423° / -17.87376° (lon /lat) while on a trip in Botswana were sent to and archived by BPC as "individuals of unknown origin". An individual African wild dog known to the Zimbabwe-based Painted Dog Conservation and part of their study population was defined as "missing" in 2013. The last record within the Zimbabwe study population was 2013-06-08 at coordinates 27.01840° / -18.75047° (lon / lat). A match between these two cases, was found by PDC staff while *validating* candidate individuals offered as *matches* in July 2022. The two sightings were > 5 years and 200 km apart, across international borders, and owned and archived by two independent organisations. This example showcases that the Wanted_Initiative has the great potential to help us understand wild dog survival and mortality based on pictures collected several years apart.

Example 2:

Pictures of African wild dogs taken by a tourist on 2017-09-27 at coordinates 23.56028° / -18.59343° (lon /lat) while on a trip in Botswana were uploaded and archived as privately-owned (akin an independent organisation). *Validation* by BPC staff of candidate individuals identified as potential *matches*, showed that the same individual was seen in five additional occasions, three of which in Zimbabwe, by tourists who had sent their sightings to BPC. Dates and locations were as follow (1) 2018-10-20 at -17.873759 / 25.234229 (Botswana, dog not collared); (2) 2019-05-25 at -17.82828 / 25.2724 (Zimbabwe, dog not collared); (3) 2019-08-07 at -17.82828 / 25.2724 (Zimbabwe, dog not collared); (4)2019-11-10 at -17.91904 / 25.45199 (Zimbabwe, dog now wearing a collar from a Zimbabwe-based organisation); (5) 2020-01-29 at -17.79475 / 25.18887 (Botswana, dog still wearing a collar). Maximum straight-line distance covered was > 200 km and cumulative distance > 250 km.

3. MAIN SCIENTIFIC FINDINGS AND RELEVANCE FOR MANAGEMENT AND CONSERVATION

During 2022 we made some important progresses in the analysis of the data collected so far, and we were able to prepare one scientific article that has recently been accepted for publication in the international journal *Landscape Ecology* and that will be available starting March 2023 at https://www.popecol.org/research/african-wild-dog-dispersal-and-demography/ (page bottom). This article is of high relevance for management and conservation as it allows simulating dispersal trajectories. In a second step, these simulated trajectories will allow investigating how changes in the environment may affect dispersal. I briefly summarizing the main findings here.

3.1. A THREE-STEP APPROACH FOR ASSESSING LANDSCAPE CONNECTIVITY VIA SIMULATED DISPERSAL: AFRICAN WILD DOG CASE STUDY

To date, connectivity has mainly been investigated using methods that make assumptions that are hardly applicable to dispersing individuals. While these assumptions can be relaxed by explicitly simulating dispersal trajectories across the landscape, a unified approach for such simulations is lacking.

We propose and apply a simple three-step approach to simulate dispersal and to assess connectivity using empirical GPS movement data from dispersing African wild dogs and a set of habitat covariates. In step one, we create a mechanistic movement model describing habitat and movement preferences of dispersing individuals. In step two, we apply the model to simulate dispersal across the entire Kavango-Zambesi Transfrontier Conservation Area. Finally, we derive three complementary connectivity maps to showcase our results.

We successfully parametrized a detailed dispersal model that described dispersing individuals' habitat and movement preferences, as well as potential interactions among the two. The model substantially outperformed a model that omitted such interactions and enabled us to simulate 80,000 dispersal trajectories across the study area. By explicitly simulating dispersal trajectories, our approach not only requires fewer unrealistic assumptions about dispersal, but also permits the calculation of multiple connectivity metrics that together provide a comprehensive view of landscape connectivity. Overall, our study demonstrates that a simulation-based approach offers a simple yet powerful alternative to traditional connectivity modelling techniques. It is therefore useful for a variety of applications in ecological, evolutionary, and conservation research.

3.2 AFRICAN WILD DOG DISPERSAL AND CONNECTIVITY UNDER CLIMATE CHANGE - LESSONS LEARNED FROM SEASONAL FLOOD EXTREMES

Climate change is expected to profoundly impact the life history of wild-living animal populations. While the impacts of climate change on the demographics of local subpopulations have been studied repeatedly, less is known about the consequences of environmental change on dispersal and connectivity.

We capitalize on a natural experimental setup, the highly dynamic flood of the Okavango Delta in northern Botswana, to investigate the impact of changing environmental conditions on dispersal patterns and connectivity of the endangered African wild dog (*Lycaon pictus*). We analyze dispersal trajectories across the Okavango Delta under two observed extreme scenarios; a maximum and a minimum flood extent covering an area of 3’000 and 10’000 km^2, respectively. These scenarios approximate environmental conditions under growing climatic variability, as it is expected under continued climate change.

During maximum flood, the Okavango Delta poses an important barrier reducing dispersal prospects and increasing dispersal duration. At maximum flood, dispersal into some areas is reduced by 77% and dispersal durations increased by 19%. Averaged across the entire study area, we observed a 12% lower dispersal success and 17% longer dispersal durations during maximum flood. We also found that at maximum flood, dispersal corridors and areas with a high potential for human-wildlife conflict shift towards densely populated areas.

Whilst the effects of climate change on the pulsing regime of the Okavango Delta remain unknown, our results suggest that any change in the flood extent can have stringent consequences on dispersal patterns and connectivity. Considering such differences will be key to designing future conservation strategies and dispersal corridors, particularly in light of ongoing climate change.

4. CAPACITY BUILDING, NATIONAL NETWORKING AND OUTREACH ACTIVITIES

During 2021, we continued to intensify and tighten our information exchange with tourists and tour operators in the tourism sector, with the aim to obtain wild dog pictures across the Okavango-Chobe and KAZA/TFCA ecosystems.

Data analysis is planned for 2022.

We continue fruitful collaboration and data exchange with other researcher groups active at the regional/national level including, among others, Cheetah Conservation Botswana, WildCRU's Trans-Kalahari Predator Programme, University of Botswana and the Okavango Research Institute, Leopard Ecology and Conservation, Rhino Conservation Botswana.

5. TEAM UPDATES

During 2022, we said goodbye to Olorato Dipuo, from Sankuyo, who worked as communication officer in charge of maintaining and enhancing relationship with the tourism industry, the Department, and to monitor dispersing individuals. Olorato Dipuo had obtained an exciting and stimulating job in the tourism industry and we wish him all the best for his future.

Megan Robinson, who had worked as field research assistant during 2021, joined our team as prospecting MSc student during 2022. Megan will be investigating differences in movement and activity behaviour between dispersing and resident African wild dogs.

6. INTERNATIONAL COLLABORATION

We continue to consolidate our collaborating with the US-based non-profit organisation Wild Me (https://www.wildme.org), which is specialized in patterns recognition analysis. The aim is to finalize an algorithm that will be able to automatically identify individual wild dogs from pictures. Such algorithm is the backbone of the African Carnivore Wildbook (http://www.africancarnivore.wildbook.org) platform, where images are uploaded and processed. This platform is curated by the Canada-based Tech4Conservation organisation (http://t4c.org). This platform now allows citizen scientists to upload their wild dog sightings, which will contribute to increase the amount of information available to us.

Our team has been directly involved in the organisation of a conference on African wild dogs held virtually between 14 – 18 February 2022 (https://wilddogs.org). The conference is hosted, among others, by Endangered Wildlife Trust, IUCN Canid Specialist Group, Zoological Society of London, African Wildlife Conservation Fund, Botswana Predator Conservation.

7. FUTURE PERSPECTIVES AND DIRECTIONS

Our project is a complementary project to the long-term wild dog research and monitoring program at BPC. We therefore see the dispersal project as a long-term project to be developed and integrated in other wild dog-related activities at BPC. The novelty of the dispersal project is that it adds a new spatial and population dynamic dimension to BPC wild dog research. However, the core of the dispersal project remains the wild dog population resident in the Okavango Delta, which acts as the source for the dispersing wild dogs focus of this study.

In the short term, we plan to continue our research, which focuses at understanding the fate of individuals that disperse from the main BPC study area across northern Botswana and use this information to assess population viability under changing environmental and anthropogenic scenarios.

In the medium to long term, we can foresee expansion of activities to a larger national (and international) extent, and this will be much dependent on the movement trajectories of the dispersing wild dogs. We would also welcome a collaborative effort with other researchers working in other areas of the country to gather information on dispersing wild dogs across different ecosystems. This information will be invaluable given the mosaic of ecosystems that characterize Botswana and the KAZA/TFCA landscape. Only through long-term commitment and long-term data we will be able to address some key questions whose answers will allow to help management and conservation of the species.

In accordance with the Botswana National Wildlife Conservation Research Action Plan, through our wild dog dispersal project we aim to provide scientific information and advice to policy makers, resource managers, stakeholders, and the public. The information gathered through the wild dog dispersal project will provide evidence-based information for the conservation and management of the African wild dog, nationally and internationally. In this respect, the spatial extent of the dispersal project can help support research and conservation across transboundary ecosystems such as the KAZA/TFCA, for which we identified Botswana as a key African wild dog conservation hub.

8. ACKNOWLEDGEMENTS

We are immensely thankful to the following parties for their financial support (in alphabetical order): Albert-Heim Foundation, Basler Foundation for Biological Research, Idea Wild, Jacot Foundation, National Geographic, Parrotia Foundation, Swiss National Science Foundation, Temperation Foundation, University of Zurich, Wilderness Wildlife Trust, the many sponsors of the Botswana Predator Conservation Program.

In Botswana, we have been supported and assisted in various ways by (in alphabetical order): Belmond Safaris, Bushways Safaris, Desert & Delta Safaris, &Beyond, Kwando Safaris, Natural Selection, Machaba Safaris, Sanctuaries Retreat, Sankuyo Tshwaragano Management Trust, Under One Botswana Syk, Wilderness Safaris, and by Bushman Plains Camp, Chitabe Lodge, Mogotlho Safari Lodge, Nxabega Lodge, Qorokwe Camp, Sandibe Lodge, Xigera Lodge.