ANGOLA | BOTSWANA | NAMIBIA | ZAMBIA | ZIMBABWE

kaza
Kavango Zambezi Trans Frontier Conservation Area
Angola
Botswana
Namibia
Zambia
Zimbabwe

KAZA

ELEPHANT SURVEY 2022

FACT SHEET

Accurate information on the population and distribution of elephants and other large herbivores in the Kavango Zambezi Transfrontier Conservation Area (KAZA TFCA) is essential to informing conservation efforts and wildlife management in the region.

Following several years of preparation, the KAZA Elephant Survey (2022) commenced on 22 August 2022 and ran until 28 October 2022.

The results are presented in a series of reports - An aerial survey of elephants and other large herbivores in the Kavango Zambezi Transfrontier Conservation Area, Volume I: Results and technical report and Volume II - Stratum Reports.

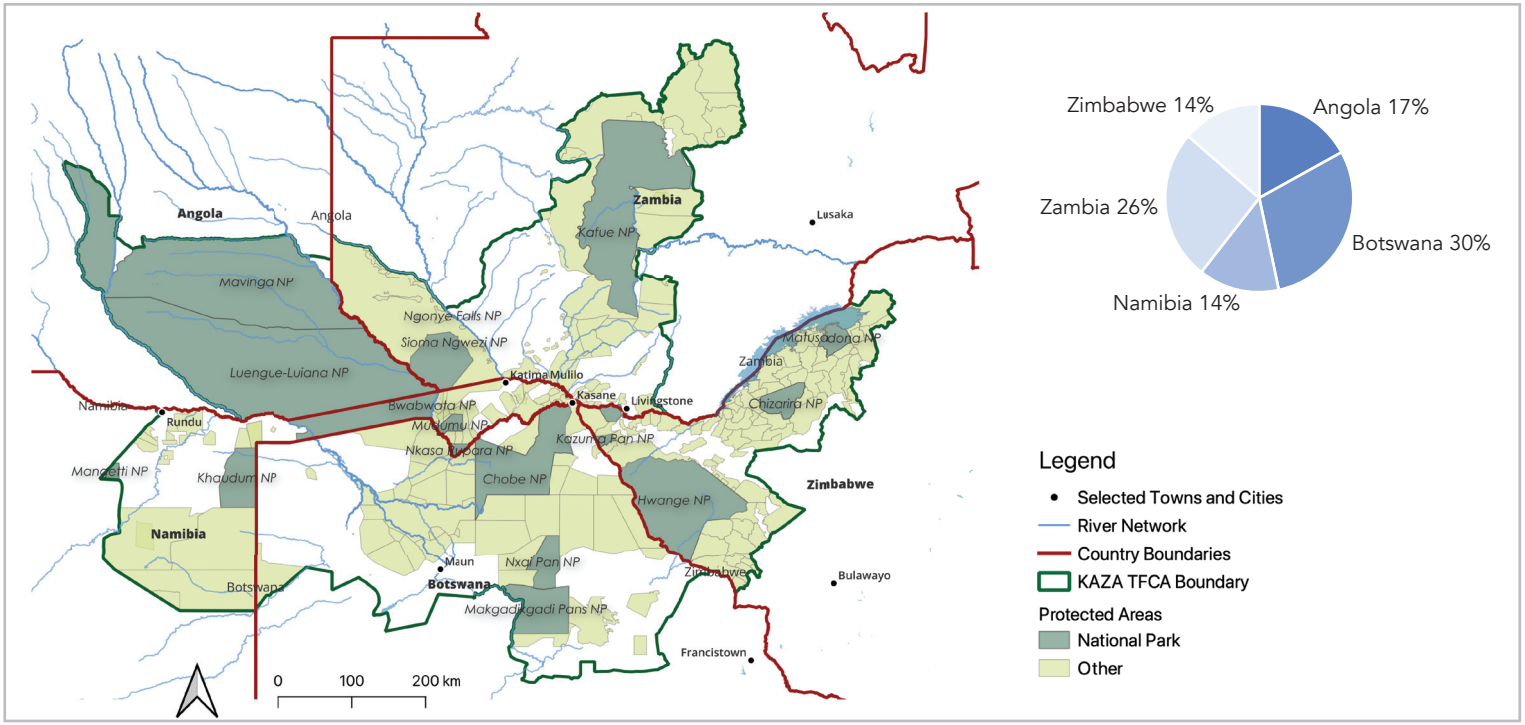
This brief summary provides an outline of high-level findings along with the rationale for the work, including the need for a synchronised and co-ordinated approach and an outline of the survey techniques employed.

KAZA Background

KAZA MISSION: To sustainably manage the Kavango Zambezi ecosystem, its heritage and cultural resources based on the best conservation and tourism models for the socio-economic wellbeing of the communities and other stakeholders in and around the eco-region through harmonization of policies, strategies and practices.

19	60	47	110	2011	519 912 km²
National Parks	Forest Reserves	Communal Conservancies and Forests	Game or Wildlife Management Areas	KAZA TFCA treaty signed in August that year	Area Covered by the KAZA TFCA

THE ELEPHANT POPULATION IN KAZA represents over 50% of the remaining African savanna elephants (Loxodonta africana) on the continent.



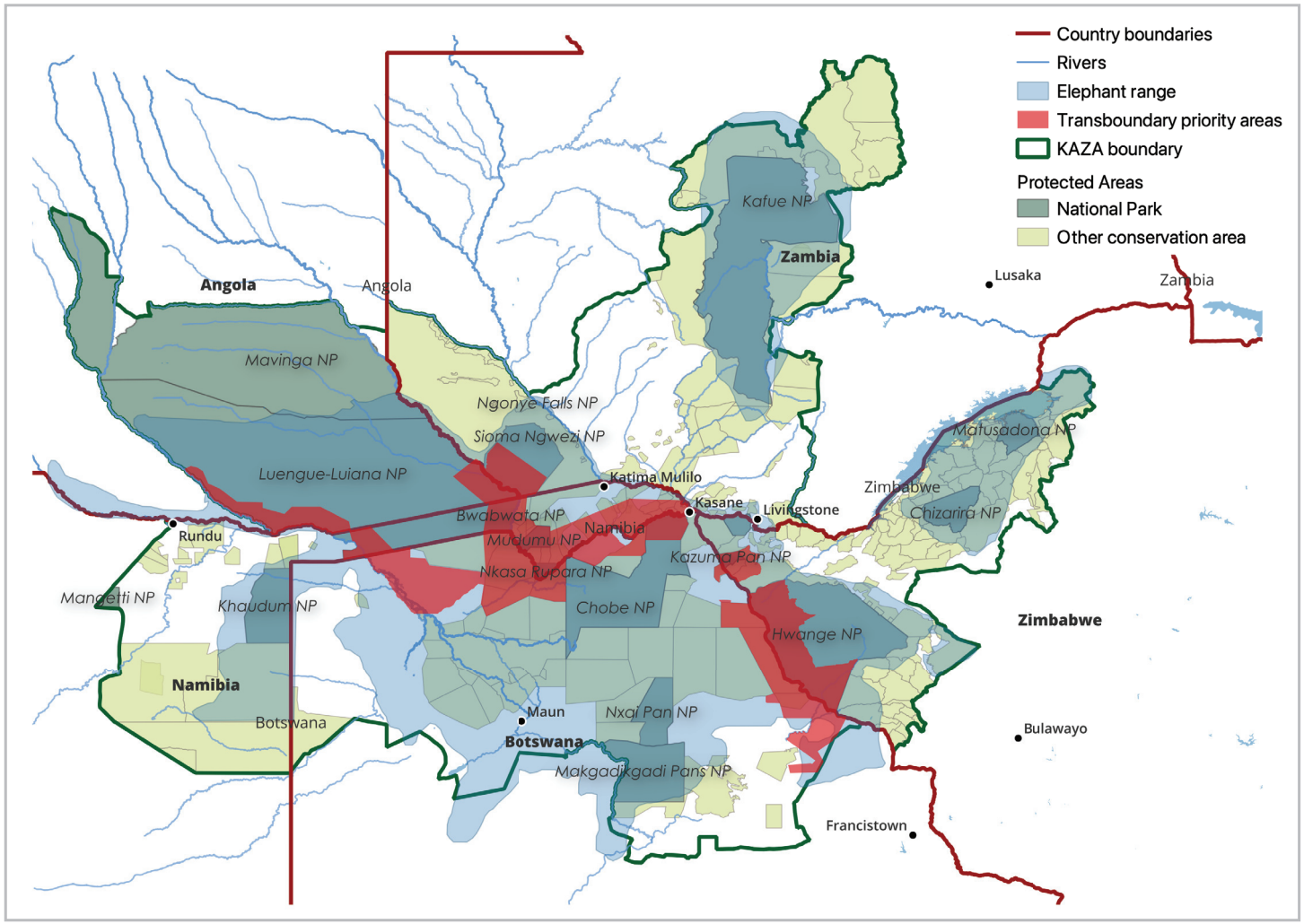
KAZA ELEPHANT SURVEY 2022 OBJECTIVE: The primary objective was to obtain a relatively precise and accurate estimate of the number of elephants in the KAZA TFCA, using techniques that can be implemented within a reasonable time and at a reasonable cost. The survey also aimed to estimate the numbers of other large herbivore species (wild and domestic) and elephant carcasses in the KAZA TFCA.

Cross-Border Movement of Elephants

TRANSBOUNDARY ELEPHANTS: Elephants range over this diverse landscape, regularly moving across international boundaries, in search of water and forage, and in response to pressures such as competition, fire, drought, habitat loss or other human-related stresses such as poaching or human-elephant conflict.

Using GPS collar data, a number of studies have documented significant elephant movements throughout the KAZA landscape.The map to the right shows the potential elephant range across the KAZA TFCA from existing data. The segments across international boundaries depicted in red are areas where it is known that significant cross-border movement of elephants takes place.

Such movements mean that while the survey is taking place, elephants can move from one survey area to another, posing the risk of counting a substantial number of individuals twice or not at all. To avoid this situation, several aircraft need to be deployed in a synchronised manner. In the case of transboundary movements, it is therefore necessary to conduct simultaneous flights, or very nearly so, on both sides of the international border. This poses logistical challenges and requires careful coordination amongst survey crews.

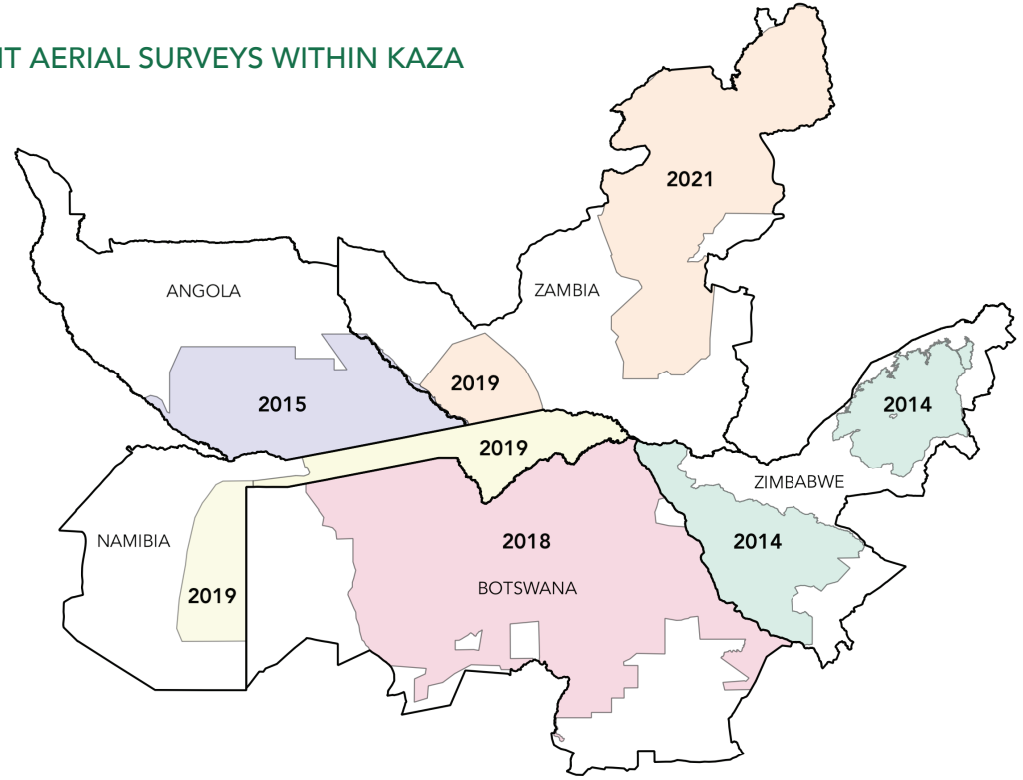


Need for a Synchronised and Coordinated Approach

INDEPENDENT IN-COUNTRY INITIATIVES

In most cases, aerial surveys are the result of in-country initiatives at the scale of a protected area or region. They may sometimes be the result of a national initiative, but they rarely involve several governments. These independent surveys are made possible by the resources available at the time in the respective countries and are therefore conducted at different times, in different years, often using different methodologies and standards, making it difficult to compare results between sites and across time. The EU-funded Eles Map project in 1995 was an exception, with coordinated surveys across southern African countries.

RECENT AERIAL SURVEYS WITHIN KAZA



Country	Region	Survey Year
Angola	South-eastern Angola	2015
Botswana	Southern Botswana	2012
	Northern Botswana	2018
Namibia	Kavango Zambezi region	2019
	Khaudum NP and neighbouring conservancies	2019
Zambia	Kafue NP & neighbouring GMAs	2021
	Sioma Ngwezi NP and GMAs	2019
	Mosi-oa-Tunya NP, Kazungula	2008
Zimbabwe	North-west Matabeleland	2014
	Sebungwe region	2014
	Chizarira NP and Chirisa Safari Area (portions of Sebungwe)	2020

CROSS BORDER SYNCHRONISATION: The Great Elephant Census (2014-2015) was a continent-wide initiative to survey savanna elephant populations across Africa over the same time period, adhering to the same standards. The main problem that the GEC team highlighted with this massive undertaking was the lack of synchronisation of flights at the regional level to take account of the transboundary movements of elephants within their ecosystems.

Need for a Synchronised and Coordinated Approach

SETTING STANDARDS

Over time, conservationists have increasingly standardised their approaches, methods and survey practicesto ensure repeatability and comparability across different locations and time periods.

The CITES MIKE Aerial Survey Standards were initially developed by the CITES MIKE CSU on behalf of the CITES COP, and have been revised over time with the latest version being published in 2020. It is a document of about 50 pages that deals with aerial survey methods, survey planning, survey equipment, crew requirements, survey implementation, data analysis and data reporting.

CITES MIKE refers to the Monitoring the Illegal Killing of Elephants program, which is a component of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). It aims to monitor and assess elephant populations and the levels of illegal killing of elephants, as well as the trade in elephant products

SYNCHRONISATION

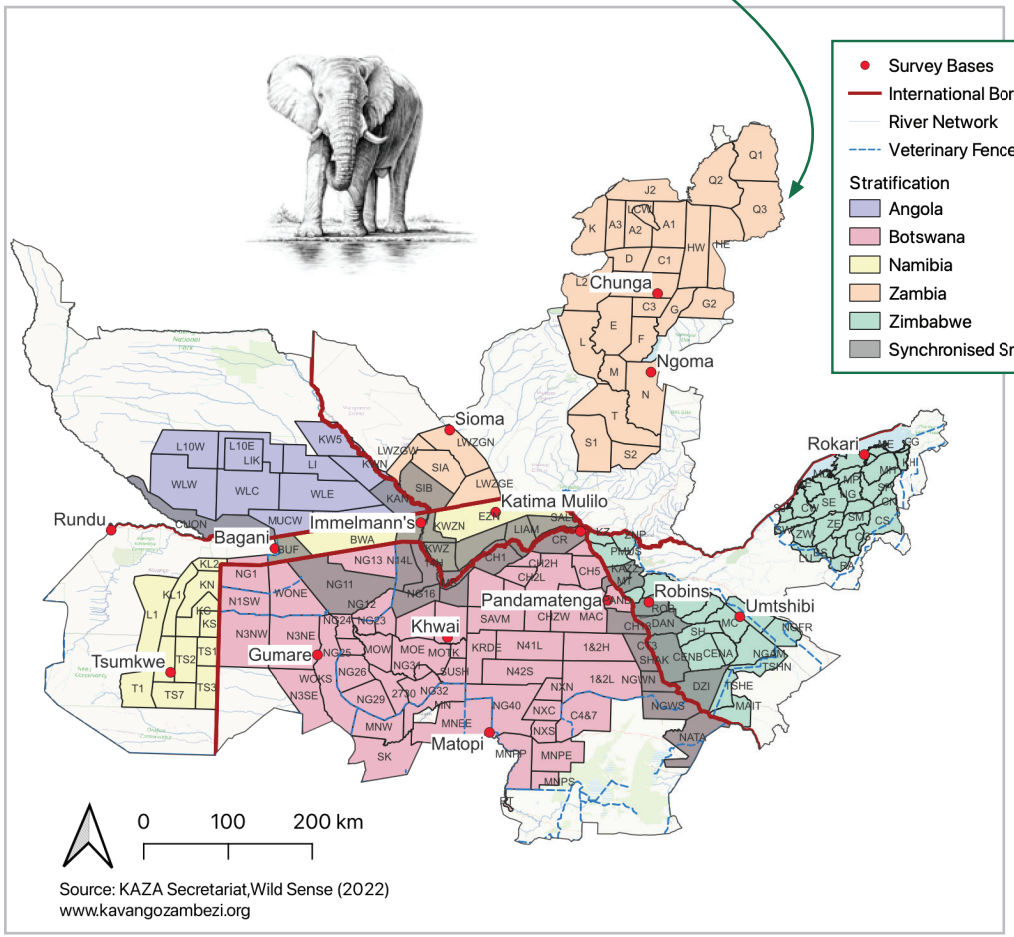
The design of the KAZA Elephant Survey was based on a flight plan that minimises the time taken to fly over these areas of transboundary movement, to avoid the risk of double counting, or missing, entire elephant herds, which could influence the estimated numbers.

COORDINATION

Due to the extensive scope of this survey and the necessary crews for its implementation, centralised coordination was crucial for its success. It promoted seamless teamwork among survey teams, reduced inconsistencies, and enforced standardised procedures. Serving as the primary channel for communication and direction, central coordination ensured the survey's objectives were executed smoothly and accurately. It also guaranteed precise timing across international borders.

STRATIFICATION

The entire KAZA TFCA survey has been divided into census units called strata, so that within each stratum (singular), elephant density is relatively uniform. Well-planned stratification can increase the precision of the estimated number of elephants in the study area.



Aerial Survey Technique

SAMPLING

- Transects
  A transect is a long, straight and relatively narrow (300m) sampling unit within a stratum. In sample surveys, transects within one stratum are parallel to each other.
- Blocks
  A block is a sampling unit within a stratum which may be square or rectangular, or irregularly shaped and demarcated on the ground by physical features such as roads or watersheds.

RECONNAISSANCE FLIGHTS

Informal low-altitude "recce" flights aim to identify and gather information on elephant populations.These flights typically explore areas near water sources and riverine vegetation, helping identify potential survey area and providing a minimum population estimate in the absence of formal surveys.

FLIGHT PARAMETERS

Transect targets:

- Height above ground: 300 ft ± 30 ft
- Ground speed: 170 kph, < 185 kph
- Observer strip width: 150 m ± 15 m

Block targets:

- Height above ground: ≤ 700 ft (Compromise between optimal height for viewing animals and safety).
- Ground speed: ≤ 140 kph

TIME PERIOD

The survey is conducted during the dry season months of August, September and October, when most trees and shrubs in the landscape are leafless, and before the first rains, to maximise visibility of wildlife from the air, and reduce the risk of elephants dispersing over long distances to take advantage of fresh graze and browse.

AIRCRAFT

Suitable high-wing aircraft are used for the survey:

- Transect: Four-seater Cessna 182's and six-seater Cessna 206's
- Block: Tandem-seat Piper Super Cub

GROUND SUPPORT

Data Managers
Logistics Team

The data managers oversee the uploading, transcribing, and archiving of data in a consistent manner.

DATA QUALITY ASSURANCE

Daily data quality procedures are adhered to by both ground teams and the operations room. Performance is reviewed and discussed, with results compared to flight parameter targets, ensuring consistent data quality. Any identified issues are promptly reported by ground teams to the operations room for resolution.

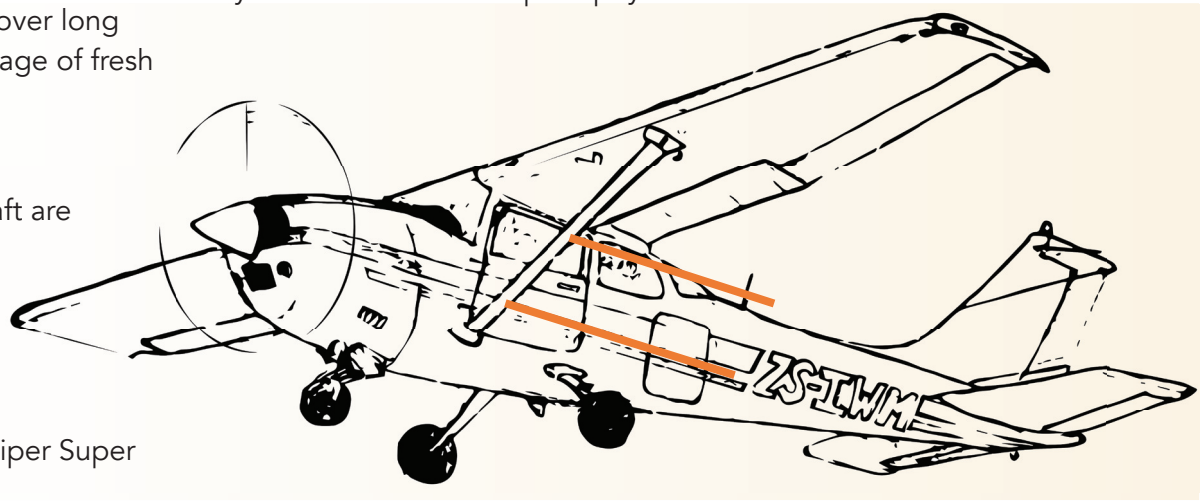
CREW

1 Pilot
1 Front Seat Observer
2 Rear Seat Observers

The pilot must adhere to flight parameter targets.

The front seat observer supervises the work and records all data on paper and in the GPS units.

The rear seat observers scan the landscape between the strip marker rods and count wildlife and livestock.



Aerial Survey Technique

REAR SEAT OBSERVERS

Experienced and skilled individuals known as Rear Seat Observers carefully spot and tally the animals they see on either side of the plane, using rods on the plane's struts to define a specific "search strip."

Additionally, fixed cameras are employed to cross-check and verify the observations made during each flight. They take photographs of large herds (>9) and elephant carcasses.

In addition to possessing exceptional eyesight and wildlife recognition abilities, the aircraft crews must also have strong stomachs and stamina to withstand air turbulence, steep turns, and prolonged hours spent in the sky.

FRONT SEAT OBSERVERS

The Front Seat Observer, who is seated next to the pilot, is primarily responsible for recording the wildlife observations called out by the Rear Seat Observers. They also manage the quality of the survey by continually checking on the performance of the rest of the crew, and monitoring the altitude and speed maintained.

GROUND SUPPORT

The aircraft teams receive support from a diverse ground crew that is responsible for tasks such as camp management, refuelling and resupply, data entry and management, and overall survey coordination.

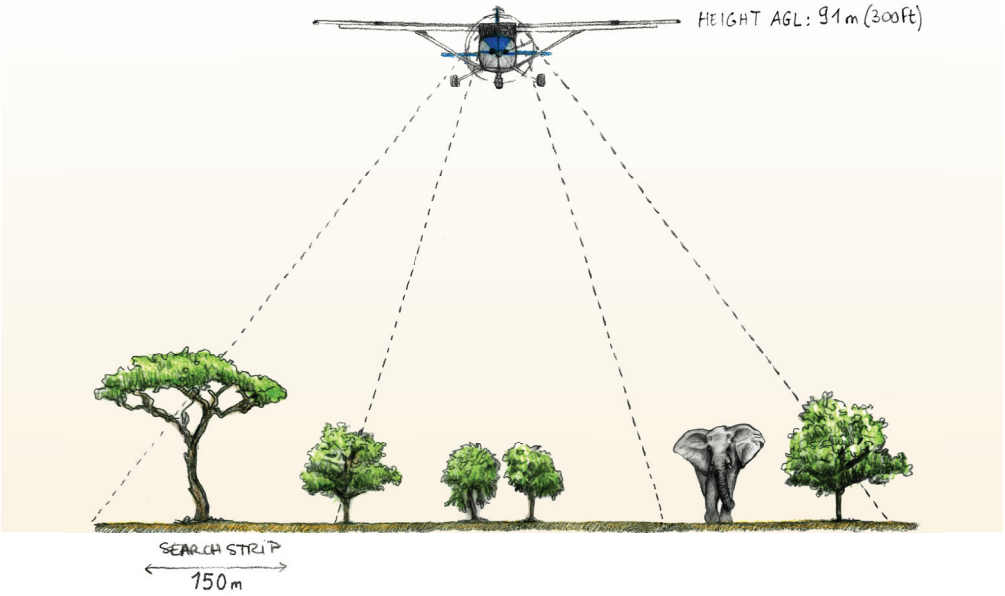
The survey flights generate a substantial volume of data that must be organised and analysed.

PILOTS

Throughout the exercise, it is crucial for pilots to maintain a steady speed and altitude above the ground, as any variations in these factors can impact the efficacy of the observers and alter the size of the area being surveyed. The target ground speed is 170km/hr, and target altitude is 300ft above ground level.

MAKING OBSERVATIONS

During the flight, the observers will call out their sightings and trigger the cameras via remote release. These observations are recorded by the Front Seat Observer who marks a GPS position for the observation while noting the species, number seen, side of the aircraft it was observed, and whether it was in or outside of the search strip.



SEARCH STRIP

Prior to commencing the aerial survey, it is necessary to install two rods on each wing strut of the aircraft. The "Rear Seat Observers" utilise these rods to delineate the sampling area in which they will make their observations.

When the rods are installed correctly in relation to the observers' position, and the aircraft is flying at an altitude of 300 feet above the ground, a search area is established on the ground that is 150 meters wide on each side of the aircraft. Animals that are counted within this search strip are the only ones used for the population estimations. Extrapolations are made based on the data obtained from these fixed areas to arrive at estimates for the whole survey area.

Prior to conducting the survey, each aircraft and crew must perform "calibration" flights over an airstrip. They count calibration markers at varying altitudes to ensure proper configuration. This data verifies the observer's positioning of strut rods and search strips and confirms the accuracy of the aircraft's laser altimeter.

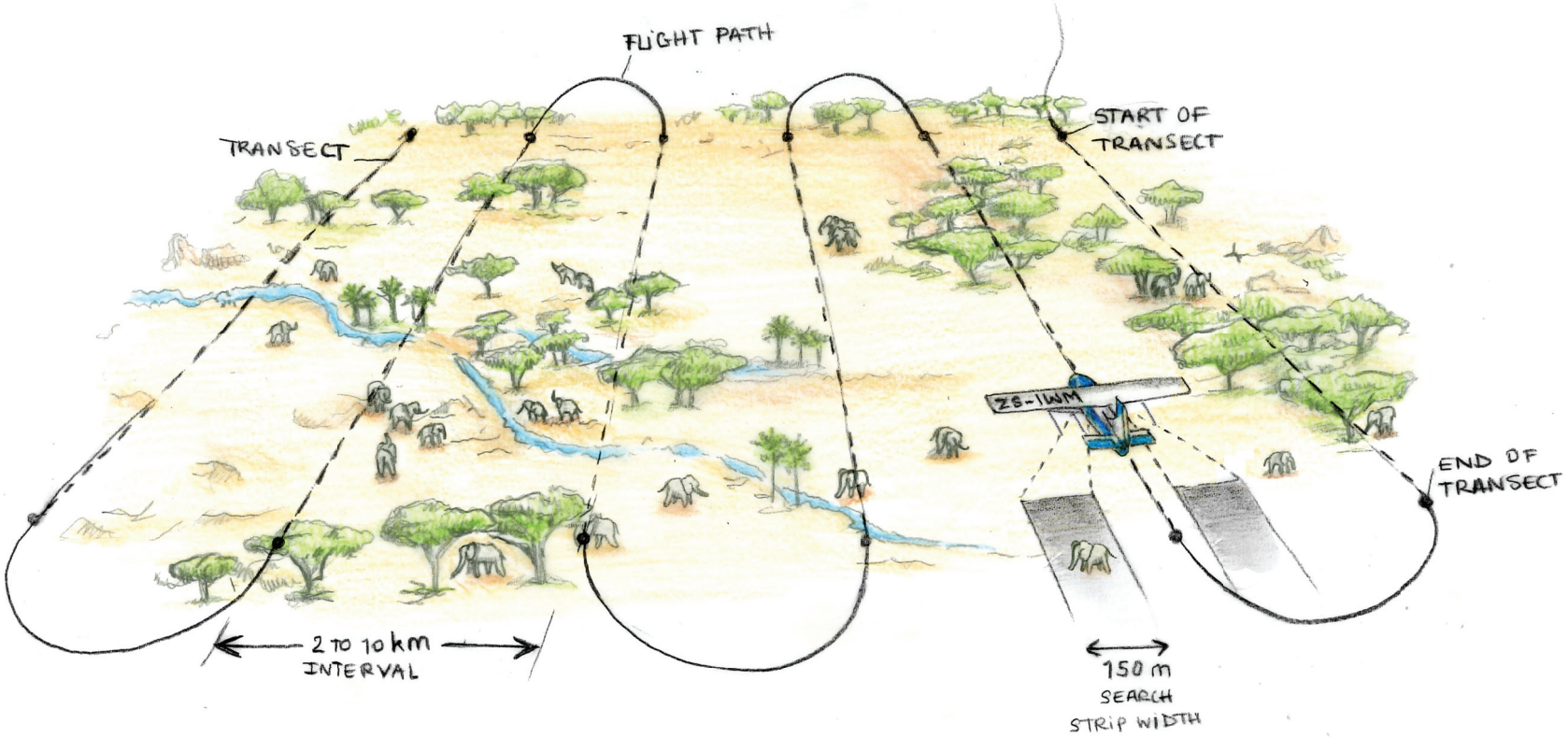
Aerial Survey Technique

WHAT IS A SAMPLE COUNT?

A sample count is based on the concept that the population (of a wildlife area or stratum) can be determined by calculating the density in a representative sample. Two crucial assumptions underlie sample counts. The first assumption is that all animals within the sample area or unit are observed and accurately counted. The second assumption is that animals are randomly distributed throughout the entire wildlife area or stratum being estimated. By acknowledging these assumptions and applying proper sampling methods, sample counts provide valuable insights into the population size and distribution of wildlife, which is essential for effective wildlife management and conservation efforts.

HOW ARE AERIAL SAMPLE COUNTS CARRIED OUT?

The systematic transect sampling method is the most widely used aerial sampling technique. It involves dividing the area of interest, or stratum, into transects that serve as sample units. These transects are oriented perpendicular to the environmental gradient of the landscape (a river for example). A subset of these transects is then searched, and the animals within them are counted. The overall population of animals is estimated by multiplying the animal density in the sample by the total stratum area. The distance between transects flown is typically spaced at 2 to 10 kilometres, depending on factors such as the target species density, level of precision required, and available resources.



Survey Timeline

BACKGROUND

- **April 2019, Strategic Planning Framework**
  This framework is adopted by the KAZA Ministers to conserve and manage the KAZA elephants as one contiguous population. A KAZA-wide synchronised aerial survey is listed as a priority action.

- **May 2019, Kasane Elephant Summit**
  KAZA Partner States raise awareness on the current status of the African Elephant in the southern African region, exchange ideas on human-elephant conflict, illegal and legal trade, and agree on concrete interventions to address the challenges posed; one of which is the KAZA-wide synchronised aerial survey.

- **October 2019, Revision of the Aerial Survey Standards and Survey Design Workshops**
  Research staff and survey biologists from the KAZA countries, gather in Kasane to revise the CITES MIKE Aerial Survey Standards, and to develop a survey design for the first ever KAZA-wide coordinated aerial survey.

SURVEY PREPARATION

- **July 2021, Project Management Setup and Fundraising**
  A technical advisory group and steering committee is set up to manage the project. At the same time, the necessary funds for the project are raised and WWF is given the role of grant manager by the five KAZA TFCA partner countries.

- **February 2022, Aerial Survey Coordination Team Appointed**
  A KAZA-wide synchronised aerial survey requires the mobilisation of numerous resources, human, material and financial, across several international borders, over a relatively short period of time, additionally the objectives and procedures for carrying out the survey must also be adopted, understood and applied by all. Synchronised efforts are therefore made possible through centralised coordination. The KAZA Secretariat and Partner States select Wild Sense to coordinate the survey.

- **April 2022, Purchase of Survey Equipment**
  In the interest of standardisation, the crews are equipped with the same high-quality equipment. The equipment is sourced from various suppliers in the region and internationally. This includes laser altimeters, digital cameras, GPSs and computers.

- **May 2022, Recruitment of Aerial Survey Contractors**
  Two suitable contractors are identified after a public tender process, both with significant experience in aerial wildlife surveying.

- **May 2022, Request of Flight Permits Submitted**
  The procedures for acquiring the various flight permits in the five partner countries have been initiated and will last several months.

Survey Timeline

SURVEY PREPARATION (continued)

- **July 2022, Purchase of Avgas**
  Fuel quantities are derived from the design of the survey. Purchase of drums and distribution to the operational bases are planned.

- **20-26 July 2022, Training and Evaluation Workshop**
  Rear-seat observers nominated by the five partner states are trained and evaluated during the workshop, to ensure that the selected survey participants have the skills and experience necessary to meet minimum standards.

- **15 August 2022, Aerial Survey Manual and Standards Finalised**
  It provides a step-by-step technical process to be followed to ensure that the routine activities of the survey remain consistent and in compliance with the CITES MIKE Aerial Survey Standards Version 3.0, 2020.

- **18 August 2022, Operations Room Established**
  A central space located at the Kasane Wildlife Office provides a live view of field operations, enabling support, coordination and data quality assurance. It is a data hub for a decision support system.

- **22 August 2022, Survey is Launched**
  The first calibration flights take place in Sebungwe, Zimbabwe.

Operations Room in Kasane

Training and Evaluation Workshop in Kasane

Survey Timeline

SURVEY IMPLEMENTATION

The data collection or flying aspect of the survey was carried out over two months during the height of the dry season.

- 22 August – Survey launch in Sebungwe
- 26 August – Launch in Kafue
- 01 September – Launch in NW Matabeleland
- 09 September – Zimbabwe portion complete
- 17 September – Kafue portion complete
- 20 September – 50% of all strata complete
- 11 October – Botswana portion complete
- 15 October – Namibia portion complete
- 24 October – Angola portion complete
- 28 October – Sioma portion complete

DATA ANALYSIS

Following the completion of the survey in October, the team of data analysts worked within the operations room to scrub the data and perform preliminary analysis, as well as complete the photo interpretation process. This initial data analysis took two months to complete.

From January onwards, the coordination team worked on finalising the data analysis and compiling the survey report, which was completed in April 2023. From May to July, the report underwent by review by the Partner States and by a team of independent experts nominated by the IUCN SSC African Elephant Specialist Group.

Operations Room

SAFETY

The flying aspect of the KAZA Elephant Survey is performed at a height of 300 feet above ground. This low-level flying is hazardous as there are greater risks of bird strikes, obstacle collisions and reduced opportunity to recover control of the aircraft from a stall or engine failure. Pilots have a high workload as they negotiate these hazards as well as the requirements to adhere to survey parameters (trajectory, height and speed). Furthermore, the operations are carried out in remote wilderness environments with added risks to the safety of crews.

To minimise these risks, strict criteria for aircraft safety and pilot competency are used, as well as flight following and emergency response protocols. The pilots hold a commercial licence, have low level survey flying experience and experience of flying in remote areas with bush landing strips.

OPERATIONS ROOM

KASANE WILDLIFE OFFICE

Located in the heart of the KAZA TFCA, close to the KAZA Secretariat office, the former conference room of the Kasane Wildlife Office has been fully refurbished and equipped with reliable electricity and internet to ensure uninterrupted operation when the aircraft are in flight.

SUPPORT

Garmin InReach satellite technology, coupled with the Earth Ranger platform, facilitated continuous aircraft tracking through two-minute intervals. This system also served as a two-way messaging platform, ensuring communication with crews regardless of operational area remoteness. This capability enabled swift support from the coordination team in response to challenges expressed by ground teams.

DATA QUALITY ASSURANCE

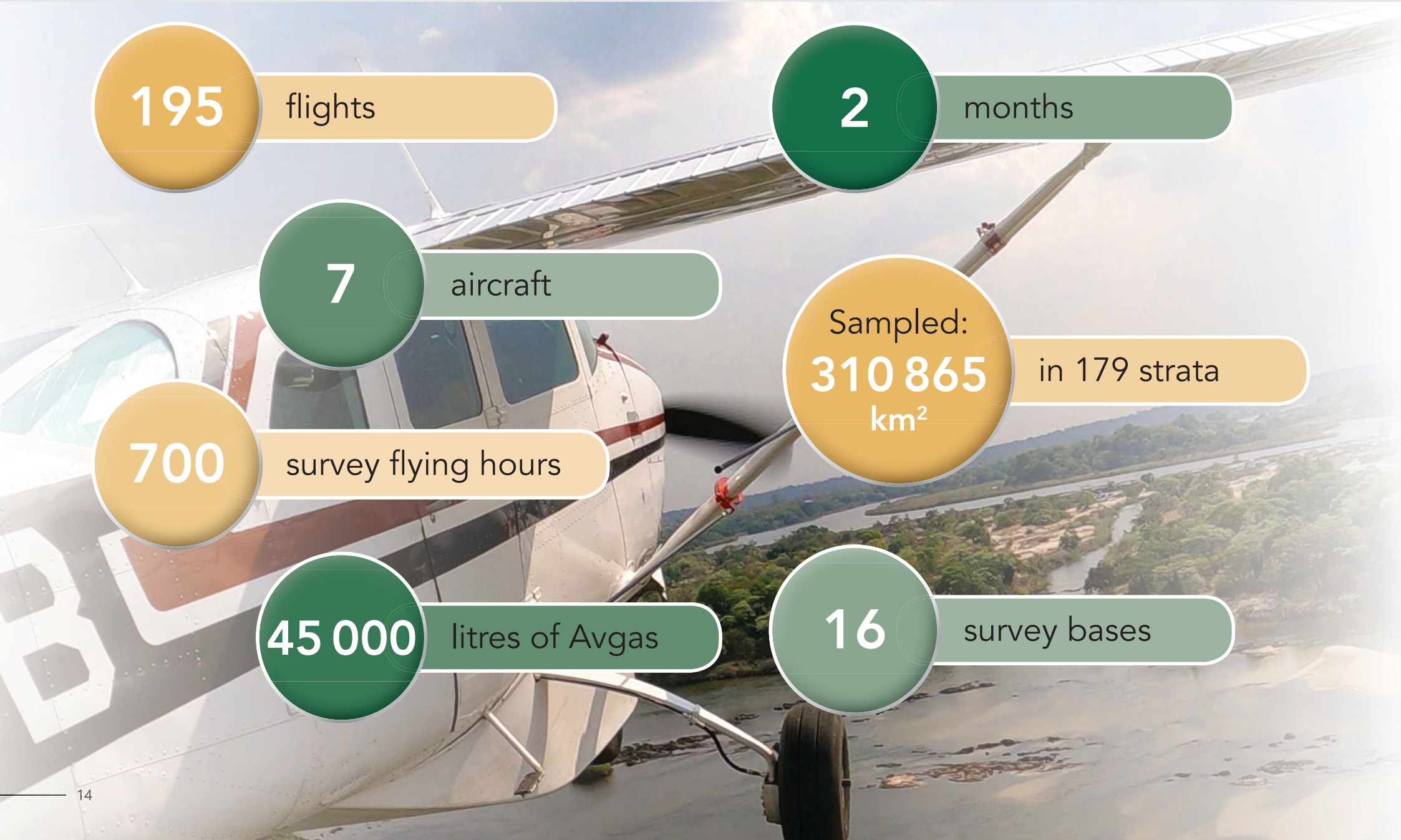
Data collected in the field during the survey was regularly sent to the operations room, where the data set was analysed using analysis software to ensure that:

1. The entire dataset was complete and transcribed in a rigorous and accurate manner.
2. The flight parameters were adhered to (assessment of the pilots' flight performance).
3. All rear-seat observers' performance meet the standards.

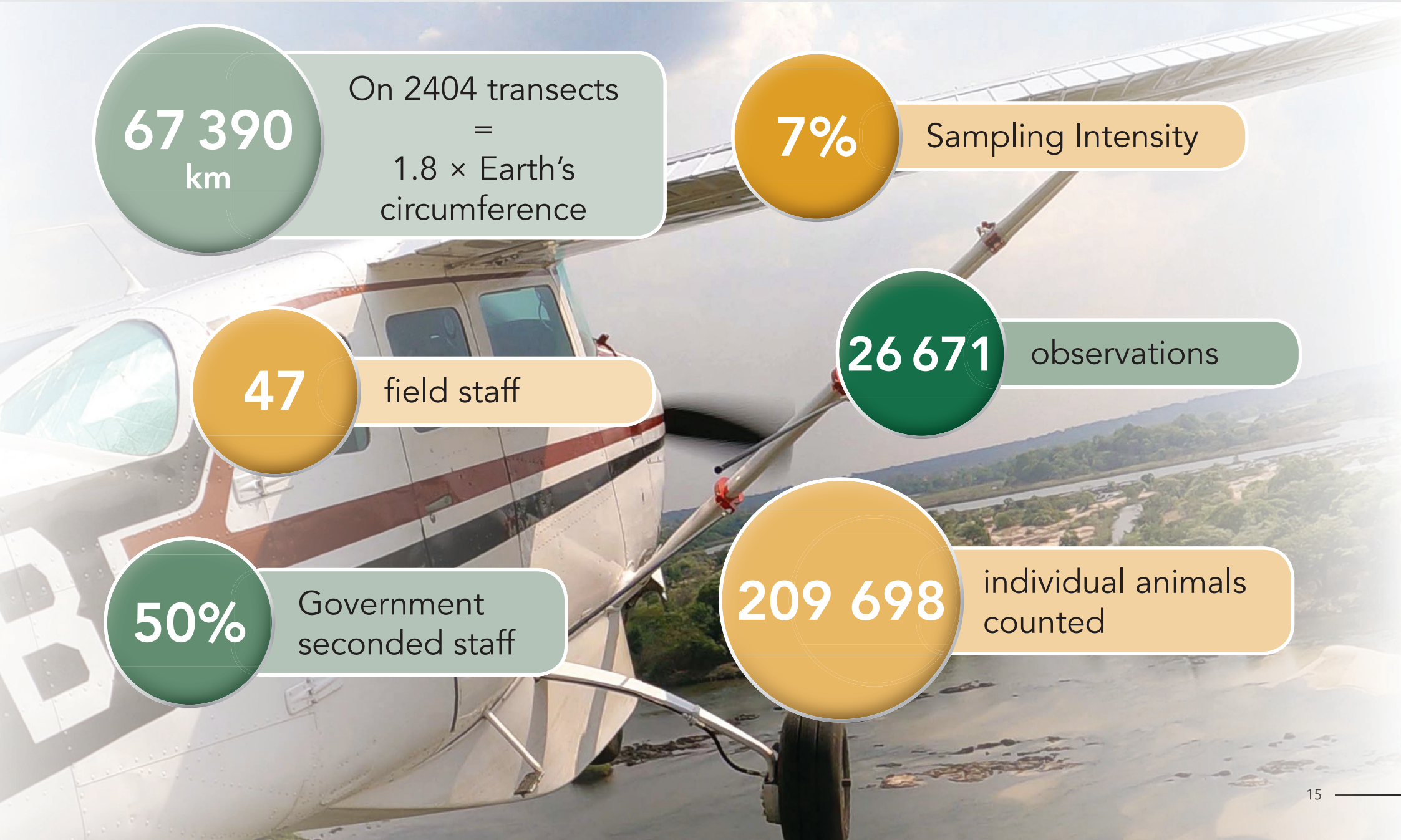
COORDINATION

Earth Ranger, a real-time software solution that integrated all survey operation components, provided a comprehensive overview of the KAZA Elephant Survey. This system facilitated streamlined coordination of security systems, personnel, and response strategies. For instance, it allowed for the tracking of daily progress, verification of design compliance, and visualization of preliminary data across all teams logically and effectively.

In Numbers


195 flights
2 months
7 aircraft
Sampled: 310 865 km² in 179 strata
700 survey flying hours
45 000 litres of Avgas
16 survey bases

In Numbers



67 390 km

On 2404 transects
=
1.8 × Earth's circumference

7% Sampling Intensity

47 field staff

26 671 observations

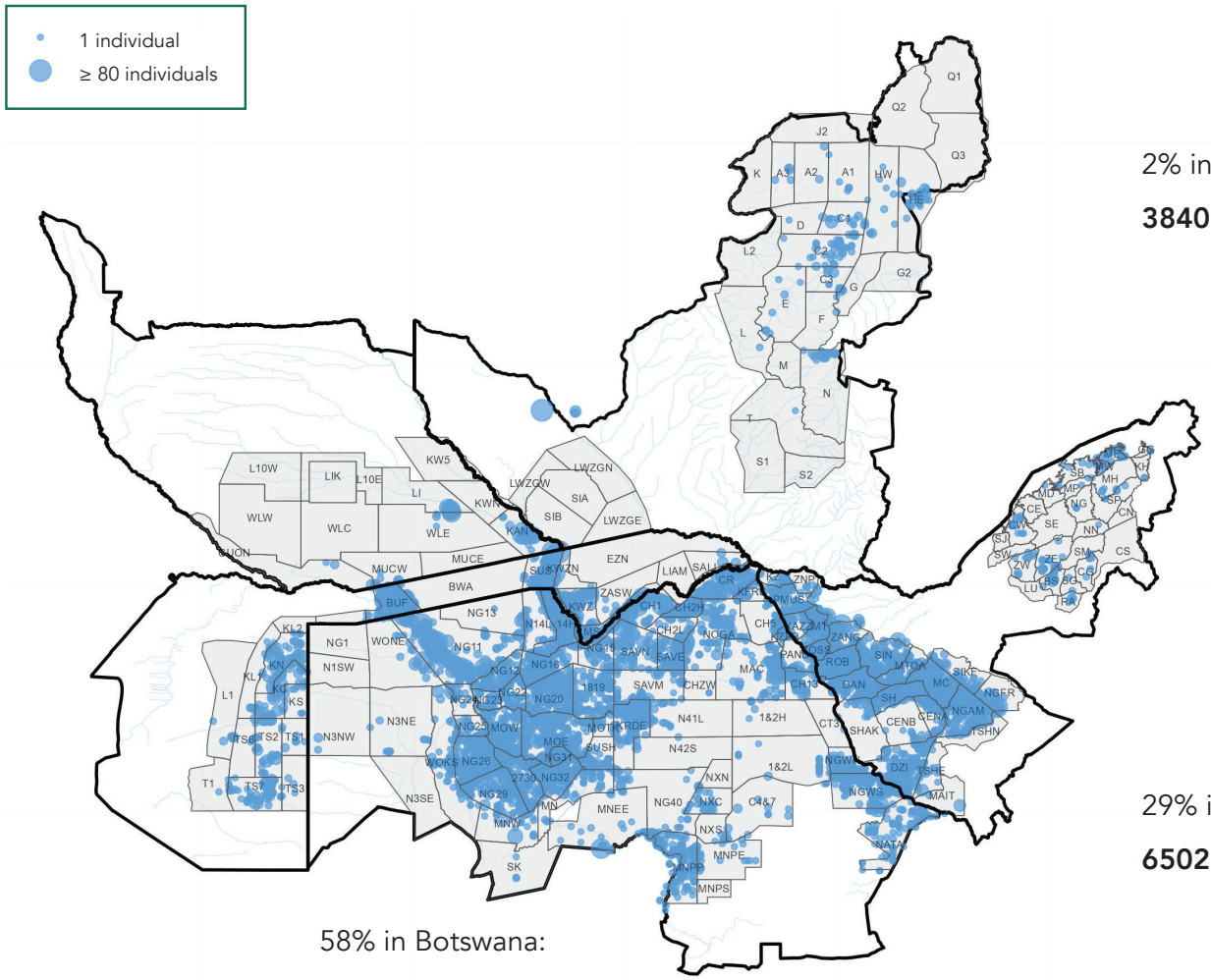
50% Government seconded staff

209 698 individual animals counted

Results

The elephant population in the KAZA survey area in 2022 is estimated to be:

227900 (±16743)



3% in Angola:

5983 (±6461)

2% in Zambia:

3840 (±1398)

9% in Namibia:

21090 (±3888)

29% in Zimbabwe:

65028 (±9457)

58% in Botswana:

131909 (±11933)

Results

Comparison of elephant estimates from this survey with those from surveys that were incorporated into the 2016 African Elephant Status Report (Thouless, et al., 2016)

	Zone	KAZA Elephant Survey 2022					2016 AESR						
		Popⁿ Estimate	95% Confidence Range		PRP	Area (km²)	Popⁿ Estimate	95% Confidence Range		PRP	Area (km²)	Survey Year	Source
			Lower CL	Upper CL				Lower CL	Upper CL				
A	KAZA	227900	211157	244643	7%	310865							
	Angola	5983	355	12444	108%	36343	3395	1778	5012	48%	41542	2015	Chase & Schlossberg, 2016
	Botswana	131909	120078	143740	9%	123666	129939	117426	142453	10%	98425	2014	Chase et al., 2015
B	Namibia	21090	17225	24955	18%	36362							
	Kavango Zambezi	12345	9863	14827	20%	18059	13136	9703	16529	26%	17474	2015	Gibson & Craig, 2015a
	Khaudum Nyae Nyae	8745	5736	11754	34%	18303	6413	3847	8979	40%	12851	2015	Gibson & Craig, 2015b
	Zambia	3840	2442	5238	36%	73830							
	Kafue	3840	2442	5238	36%	63879	6688	3945	9432	41%	45030	2015	DNPW, 2016
	Sioma	552*				9951	48	0	126	131%	4482	2015	DNPW, 2016
	Zimbabwe	65028	55571	74485	15%	40665							
	North-west Matabeleland	61531	52123	70939	15%	25045	53991	46280	61702	14%	24959	2014	Dunham et al., 2015a
	Sebungwe	3498	2478	4518	29%	15619	3407	2192	4622	36%	15527	2014	Dunham et al., 2015b

* Number counted during a reconnaissance flight, of which 508 were counted from photographs in a single herd.

A — Refers to the whole KAZA TFCA survey area.

B — Refers to the portion of the KAZA TFCA in that country. Below the country level is the superstratum, e.g., Kavango Zambezi, and this is a collection of adjacent strata combined into a larger geographical unit for which population estimates are derived.

C — The population estimate for elephants for the given zone.

D — The range of the 95 % confidence interval of the estimate. For practical interpretation purposes, the population likely lies between the lower and upper confidence limits, with the 'population estimate' representing the best approximation within that range.

E — Percentage Relative Precision (PRP) is a measure used to indicate the *precision* of an estimated population number. It is calculated as the difference between the population estimate and its 95 % confidence limits, expressed as a percentage of the population estimate itself.

F — Area covered during the survey.

Standards and Quality Assurance

CITES MIKE Aerial Survey Standards

The MIKE initiative is dedicated to employing efficient methods for producing accurate and precise elephant estimates that maintain comparability across various locations and timeframes.

In pursuit of this objective, a comprehensive set of standards has been formulated to ensure consistency and comparability. These standards underwent revisions in 2012 and 2019, receiving widespread acceptance within the field.

The CITES MIKE Aerial Survey Standards Version 3.0 is a 50-page document that outlines the guidelines governing all aspects of conducting aerial surveys for African savanna elephants, spanning from planning to execution and reporting.

KAZA Elephant Survey Manual and Standards

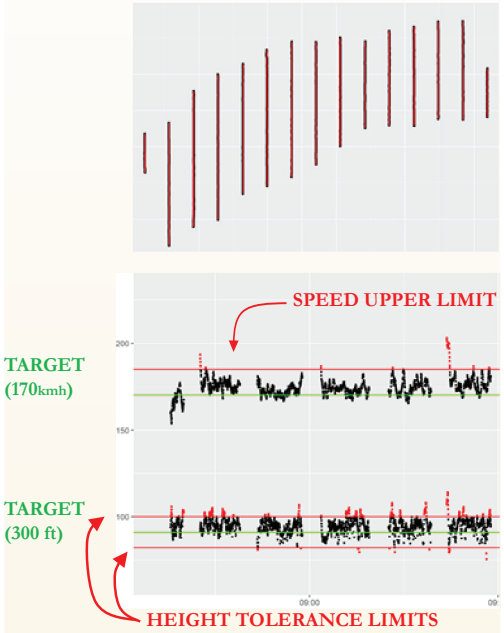
The KAZA Elephant Survey Manual and Standards is a detailed document prepared to support compliance with the CITES MIKE Aerial Survey Standards Version 3.0.

It goes two steps further:

- It outlines a series of best practices aimed at promoting efficient and optimal work among the mobilised teams, addressing the unique challenges of this enormous undertaking
- It introduces a data hub, in the form of the KAZA Elephant Survey operations room, where information is centralised, and where data are explored during the course of the survey. This emphasis on data quality assurance focuses on flight and observer performance, allowing for near real-time monitoring of data quality.

DATA QUALITY ASSURANCE

Example:
Flight V5LJB20220905A,
stratum Shapi in Zimbabwe.
15 transects, 244km, 602 elephants



LEFT OBSERVER **52,7%**

BALANCED OBSERVATIONS

RIGHT OBSERVER **47,3%**

PERFORMANCE FEEDBACK:

These daily checks are discussed among crews while in the field, to continually improve performances.

TRAJECTORY CHECK:

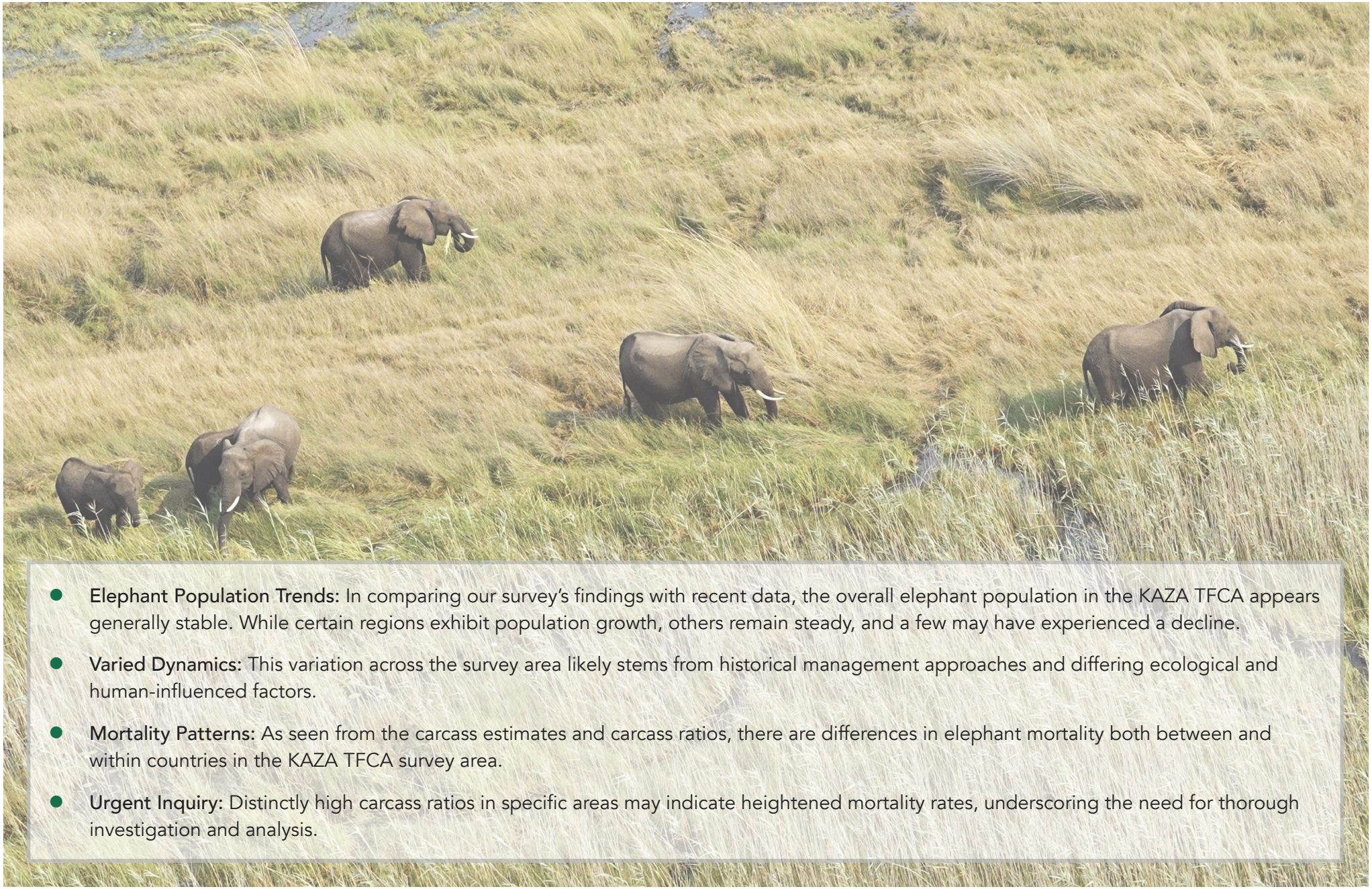
Immediately after a flight, the flight plan (red line) and the actual flight path (black line) are compared to ensure that adherence to the path of each transect is maintained.

SPEED AND HEIGHT CHECK:

Immediately after a flight, the data concerning the speed and the height of flight are dissected, for each transect, to evaluate the flight and thus the quality of the data collected. Horizontal red lines are the limits of tolerance for these variables; the green lines, are target values.

OBSERVER CHECK:

Immediately after a flight, the percentage contribution of each of the two observers to the total count is calculated. When the percentages are in the range 45% - 55%, the contributions are balanced, and the target is reached.



- **Elephant Population Trends:** In comparing our survey's findings with recent data, the overall elephant population in the KAZA TFCA appears generally stable. While certain regions exhibit population growth, others remain steady, and a few may have experienced a decline.
- **Varied Dynamics:** This variation across the survey area likely stems from historical management approaches and differing ecological and human-influenced factors.
- **Mortality Patterns:** As seen from the carcass estimates and carcass ratios, there are differences in elephant mortality both between and within countries in the KAZA TFCA survey area.
- **Urgent Inquiry:** Distinctly high carcass ratios in specific areas may indicate heightened mortality rates, underscoring the need for thorough investigation and analysis.

This survey was made possible by the funding from the Paul G. Allen Family Foundation, the German Federal Ministry of Economic Cooperation, the Dutch Postcode Lottery and its Dreamfund project, USAID's Combating Wildlife Crime in Namibia and the Kavango-Zambezi Area project, the UK Foreign and Commonwealth Development Office, the Sharjah Environment and Protected Areas Authority UAE, the US Fish and Wildlife Service, World Wildlife Fund US, Panthera and the EU funded CITES MIKE Programme.

PAUL G. ALLEN FAMILY FOUNDATION

CITES MIKE

Foreign, Commonwealth & Development Office

german cooperation

WWF

PEOPLE'S POSTCODE LOTTERY

U.S. FISH & WILDLIFE SERVICE

USAID FROM THE AMERICAN PEOPLE