ATTACHMENT 1   **Agreement #AJ46**

TERMS OF REFERENCE

AERIAL SURVEY AND CENSUS OF ELEPHANT AND OTHER LARGE HERBIVORE POPULATIONS IN THE ZAMBEZI REGION, KHAUDUM NATIONAL PARK AND NYAE NYAE CONSERVANCY

Contract period 25 September - 31 January 2016

Background

The work of this consultancy continues an overview of elephant populations that were recently surveyed in the Zambezi Region (Caprivi), Khaudum National Park and Nyae Nyae. That survey was a response to the escalating killing of elephants across the African elephant range (CITES 2012)[1] including southern Africa. This illegal activity is being driven, both internally within Africa and externally by an illegal wildlife trade. Such trade has become highly criminalized involving corrupt politicians, private sector syndicates and inept &/or corrupt bureaucrats.

In Namibia there are two major strongholds for elephant (i) in the north west of the country where desert elephant have recovered dramatically over the past 20-30 years following an earlier demise associated with poaching. This remote region can probably now be considered relatively safe and secure, compared to (ii) the north east of the country which shares borders with other countries. These borders are highly porous, vulnerable and not very secure from a poaching and illegal trade perspective.

The primary objective of this survey is to provide an estimate of elephant numbers both live and dead, so that carcass ratios (percentage of dead elephants as a proportion of live plus dead elephants) can be derived and compared with earlier such estimates, and a quantified baseline of poaching activity by location and intensity, i.e. "hotspots". Additionally other mammal species will be counted.

Duties

You will undertake the planning, design, analysis and reporting for the aerial survey and census in close collaboration with the Project Technical Supervisor (Dr RD Taylor) and the Namibian MET (Mr Kenneth Uiseb). Tables 1-3 provide carcass categories, indicative time frame and detailed survey schedule.

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[1] Further background details for elephant are provided in the sixty-second meeting of the CITES Standing Committee held in Geneva 23-27 July 2012 (SC62 Doc. 46.1).

Project Activities, Methods and Timetable

Planning, Design & Execution

Elephant and other wildlife populations will be surveyed from the air in the relevant areas in the Kavango Regions. The procedures will follow those well established for aerial surveys of African large herbivores (Norton Griffiths 1978) and utilised during earlier surveys of elephants elsewhere in southern Africa. Stratum boundaries will be drawn so that elephant density within any one stratum is spatially uniform. Special attention will be paid to counting and estimating elephant carcass numbers, using carcass categories as defined by the MIKE programme (Craig 2012).

Transect Surveys

Regularly-spaced, parallel transects (flight lines) will be positioned across each stratum parallel to ecological gradients.

The start and end points for each transect will be transferred as waypoints to a GPS receiver in the aircraft (a Cessna 182) prior to flying each stratum. During surveys, the plane will be flown at approximately 160 km per hour at about 300 feet above ground level (agl).

The aircraft crew will consist of four people: the pilot, responsible for flying the plane and navigating along the transects, by reference to the GPS receiver.

The recorder, sitting next to the pilot and responsible for recording:
- the actual height of the aircraft every 30 seconds while flying along transects (from a radar altimeter)
- the time taken to fly each transect (using a stopwatch)
- the number of elephants and elephant carcasses (as well as other large herbivores, including wetland species) seen by observers and, for each group, its GPS location and the time since the start of the transect.

Two experienced observers, who sit behind the pilot and recorder. The observers are responsible for:

- looking for elephants and carcasses, and counting those seen within the counting strips
- calling all sightings of these and other large herbivore species, including rare species, to the recorder
- differentiating wherever possible, groups of elephant bulls from cow herds (although the latter may or can include some younger bulls.
- classifying the age since death for elephant carcasses (see Table 1 for details).

On each side of the plane, a counting strip, defined by two fibreglass rods attached to the wing strut, with the distance between the rods on each strut arranged so that, with the aircraft flying at 300 feet agl, the distance represents a strip about 150 m wide on the ground.

Each rod will be marked with a small piece of tape to provide the observers with a "decision point" (at this point the observer decides whether an animal is in or out of the strip). For each region, and sub-region if needed, the strip widths will be calibrated by flying the aircraft at right angles across an airstrip that has large-sized numbers arranged at 10 meter intervals along the side of the airstrip. Each observer notes the largest and smallest number within his strip and the recorder notes the aircraft's height. The nominal combined strip width

approximately 300 m) at 300 feet agl is then determined by averaging the combined strip widths, after adjusting these to 300 feet agl.

Table 1. Classification of elephant carcasses

Class	Old	New
1:	**Fresh** • intact • white droppings of vultures visible • vegetation trampled • fluid stain on ground around carcass visible (animal likely to have died within the last 3 months).	**Fresh** (<1 month). Still has flesh giving the body a rounded appearance. Vultures probably present and ground still moist from body fluids
2:	**Recent** • pieces of hide still attached • skeleton still partly articulated • no vulture droppings • no trampled vegetation • no fluid stain evident (less than 1 year old, but generally since the last rainy season, i.e. 3 - 8 months old).	**Recent** (<1 year). Rot patch and skin still present. Skeleton not scattered
3:	**Old** • bones scattered and bleached (probably died during or before the last rainy season, i.e. more than 8 months old but generally more than 1 year old and up to several years old).	**Old** (>1 year). Clean bones, skin usually absent, vegetation regrown in rot patch
4:		**Very old** (up to 10 years). Bones scattered and turning grey.

Analysis

For strata surveyed with transects, the estimated number of elephants (and carcasses) in a stratum and the confidence intervals of the estimates will be calculated using method 2 of Jolly (1969). The actual combined strip width for each transect will be calculated from the mean flying height for that transect, and the nominal combined strip width at 300 feet agl. Transect area is the product of the actual combined strip width and transect length. The mean density of elephants in a stratum is then calculated from the numbers of elephants seen within strips and the transect areas. The population estimate is the product of the mean density and the stratum area.

Population estimates for each of the strata surveyed, and for the various administrative units within these regions, will be calculated as the sum of the estimates for the individual strata within each land unit. The 95 % confidence interval (CI) of the population estimate for any land unit that comprised more than one stratum will be calculated using the method of Gasaway *et al*. (1986). From the confidence *interval*, lower and upper 95 % confidence *limits* to the population estimate are then calculated. The 95 % confidence limits can be interpreted to indicate that: there is a 95 % certainty that the true number of animals lies between the lower and upper limits; or that there is just one chance in twenty that the true number of animals lies outside the range defined by the lower and upper limits.

Search intensity (in minutes per square kilometre) for a stratum is calculated as the total time spent flying all transects within that stratum, divided by the total area of those transects. The greater the search intensity, the less the probability that observers do not observe animals that were within the strips. No corrections are applied to any of the estimates to compensate for any undercounting or missed animals.

The carcass "ratio" (strictly a percentage) is calculated as the estimated number of all elephant carcasses as a percentage of the estimated number of all elephants, i.e. live elephants plus dead ones (Douglas-Hamilton & Hillman 1981; Douglas-Hamilton & Burril 1991).

Reporting

Reports for the surveyed areas will provide an Introduction, Methods, Results and a brief, non-speculative Discussion, but should make reference to the review of the previous surveys, itself a report of this project. The Results will include:

- Summaries of sampling statistics
- Population estimates and statistics for elephants and other species

Timetable

Following planning and design during the middle of MONTH(S), it is intended to commence surveys from DATE onwards through to the end of DATES as indicated in Table 2. Analysis and report writing will commence thereafter.

Table 2.Indicative timeframe for aerial survey and census of African elephant populations and other species in Zambezi Region, Khaudum National Park and Nyae Nyae Conservancy

PHASE	DURATION
Travel	5 days
Calibration	1 day
Survey	19 days
Analysis & reporting	25 days
TOTAL	**50 days**