FILE NAME SURVEY1

Ruaha Ecosystem Wildlife Management Project

Aerial Wildlife Survey in Rift Valley sectors of Ruaha National Park (RNP) and Lunda Mkwambi Game Controlled Area (LMGCA)

Survey No. 1 13th-19th July 1994

Summary Report October 1994

Introduction

REWMP completed its first aerial wildlife survey in July 1994. The survey area is shown in the maps, in relation to physical and administrative features. The survey zone lies in the Rift Valley segment of Ruaha National Park (RNP) and Lunda Mkwambi Game Controlled Area (LMGCA). The survey covered lands around several villages where the feasibility is to be examined of wildlife utilisation projects. The main physical features of the area are the east and west escarpments bordering the Rift Valley and the Great Ruaha River which flows eastwards through the Valley.

Several aerial surveys of the area have been undertaken since 1987, mainly by Tanzania Wildlife Conservation and Monitoring (e.g. TWCM 1993). Because they cover RNP as part of the large "greater Ruaha region" (about 43,000 km^2), these surveys by necessity use relatively high flying speeds, heights above ground, transect spacings and strip widths (e.g. 200kph, 350 feet, 5km and 300m respectively).

Such techniques are useful in identifying trends in wildlife numbers but they have some limitations in that they underestimate densities of mammals such as giraffe, kudu, impala and warthog. For the REWMP survey it was decided to cover a smaller proportion of the ecosystem at a higher sampling intensity to gain a more accurate picture of wildlife populations in the area. This was especially important for the purpose of identifying wildlife populations for exploitation on village lands.

Methods

Survey area and transect location

Using the REWMP GIS, a map of the survey area was overlaid with a 2.5 km grid and transects were aligned in a north-south direction along the centre of each grid square. At the outset, flying conditions near the escarpments were not known and it was not clear precisely where each transect would begin and end. Therefore each transect was located by its longitude only. The latitudes of the start and end of each transect were read from the GPS in the aircraft during the survey. The transects flown are shown as flight-lines in the maps.

Sampling methodology

The survey was conducted using systematic reconnaissance flight (SRF) methodology as described in Norton-Griffiths (1978). The detailed survey parameters are given in Appendix One. Basic parameters were as follows:

Aircraft: Cessna 182
Transect spacing: 2.5 km
Nominal strip width (combined): 250m, giving a sample fraction of 10%
Nominal flying height: 250 feet
Nominal flying speed: 150 kph
Sub-unit length: One minute
Total area surveyed: 5564 km^2

Strips were delineated by streamers fixed to the wing struts. Strip widths were calibrated by flying at various heights over markers spaced 20 meters apart. Sampling was carried out in mid-morning and mid-afternoon to optimise incident light conditions and visibility of animals.

Rear seat observers called out sightings of large mammals to the front seat observer (FSO) who noted them down. The FSO noted the beginning of each 60 second sub-unit and for each sub-unit recorded height above ground shown on the radar altimeter. The FSO recorded the latitudes of the start and end of each transect, which were read off the GPS by the pilot.

Data analysis

Population estimates were generated using Jolly's method for unequal-sized sampling units as described in Norton Griffiths (ibid.). SRF software (Campbell), with supplementary programs supplied by TWCM, was used to perform the data analysis and generate population estimates and distribution maps.

Results

Twenty species of wild mammals were detected during the survey. Population estimates for the more frequently-counted species are shown below. Distribution maps for the more important of these, for all wildlife combined and all livestock animals combined are in Appendix Two.

Animal	Popn. Estimate	95% confidence interval (%)
baboon	364	115
buffalo	3306	89
cow	24881	31
donkey	380	66
eland	536	83
elephant	1307	43
sheep/goats	19700	35
giraffe	2636	11
impala	4340	21
kudu	596	34
ostrich	166	90
warthog	594	43
waterbuck	132	83
zebra	3424	28

Discussion

Effectiveness of technique

The adopted survey technique worked reasonably well. In future surveys it will be possible to fly the same transects using GIS co-ordinates loaded into the GPS. A new intercom system in the aircraft will make sighting reports easier to hear. It seems that the lower flying heights and speeds and smaller strip widths made it easier for observers to spot giraffe, kudu , impala and warthog.

Dry season 1993 TWCM population estimates for Ruaha National Park can be compared with the results of this survey, which covered an area about half the size:

Animal	TWCM 1993 estimate RNP (10,400 km^2)	REWMP 1994 estimate Rift Valley (5,564 km^2)
kudu	222	596
giraffe	2388	2636
impala	4068	4340
warthog	797	594

Such a comparison is crude and strictly invalid, as the techniques should be compared in the same area and at the same time. Nevertheless, it suggests the REWMP technique is more effective in detecting these species, and so REWMP estimates may be closer to the true population figures for these mammals. Accuracy is most important when monitoring sustainability of utilisation.

Population estimates

The population estimates obtained here are indices of abundance which can be compared with those obtained from future surveys using the same methodology to detect trends in wildlife numbers. Some of the population estimates are associated with large confidence intervals, which means that currently they provide little useful information for management purposes. As surveys are repeated it should be possible to improve the precision of the estimates.

A special exception in this regard is the buffalo population estimate. The buffalo population is believed to be in decline, and this may have implications for management planning. However the clumped distribution pattern of buffalo makes SRF such an imprecise monitoring tool that repeated surveys of this type will probably detect only drastic changes in numbers. A more sensitive method for monitoring buffalo is total counting of herds in the survey area; if time and funds are available total counts for buffalo would resolve the uncertainty about its status.

Large mammal distribution

The distribution maps in Appendix Two indicate the presence of various wildlife species in 5km grid squares throughout the survey area. It was not possible to draw the boundary precisely between RNP and LMGCA so this should be taken as approximate only.

The combined distribution maps for all wildlife species indicate that most wildlife is concentrated in RNP. Wildlife was present in 84% of the area surveyed in RNP, and in 37% of the area surveyed in LMGCA. Figures in the grid squares refer to density expressed in animals per square km. The highest densities of wildlife occurred in RNP and the highest densities of wildlife in LMGCA occurred close to the boundary with RNP.

Most individual species displayed similar distribution patterns, being concentrated mainly within RNP. Kudu were an interesting exception, their distribution indicating a preference for the areas used by livestock outside RNP, in the east of the survey zone. This effect has been observed in southern Africa, but its explanation is not clear. The effect of livestock on vegetation may create attractive habitat structure for the kudu.

Some groups of elephant were seen far outside RNP and these may be involved in crop-raiding. Warthog appeared sparsely but evenly distributed in RNP and LMGCA.

Implications for wildlife utilisation

A crucial factor affecting feasibility of wildlife utilisation is the distribution and density of usable animals on village lands. In consumptive terms, elephant and giraffe are not usable and they are excluded from this discussion.

The maps suggests that the villages of Kisanga, Mboliboli, Isele and particularly Mlowa, with its large shared boundary with RNP, are where wildlife utilisation will be most feasible. Large mammals occurred also in remote areas of LMGCA to the south-west of Makifu.

In the LMGCA part of the survey area zebra occurred in 3% of the grid squares, (close to RNP boundary), buffalo in 4% (near boundary), kudu in 10% (in the livestock areas to the east), impala in 12% (near boundary) and warthog in 6%. This suggests that, in terms of availability, the most suitable species for utilisation would be impala, and possibly buffalo and zebra, near the park boundary. While kudu are widely distributed there are no kudu on the present quota from Wildlife Division. Warthogs are another option depending on local acceptance of pork.

These suggestions do not address the question of the size of the resource or the level of sustainable off-takes for cropping. Crude LMGCA population estimates derived from the grid square maps are: impala 1153; buffalo 700; zebra 327. Most of these animals occur on or close to the RNP boundary.

Outlook for further surveys

Future surveys will provide more estimates of wildlife numbers and more information on wildlife distribution patterns. The next survey is planned for late October or early November 1994. A second dry season count should improve the precision of most of the current population estimates and it is hoped also to develop a better distribution mapping system. Ground surveys will be useful to obtain detail on exploitable wildlife on village lands.

References

Campbell, K.L.I., 1993, SRF: Systematic Reconnaissance Flight. Software for Aerial Survey Analysis.

Norton-Griffiths, M.,1978, Counting Animals. African Wildlife Foundation. Publication no. 1.

TWCM, 1994, Survey Report. Greater Ruaha, 1993.

Appendix One

Detailed survey parameters

Aircraft

Cessna 182 5H-FOR

Crew

Pilot: L. Patterson
FSO: S. Jennings

RSOs: B.T. Mgina, RNP
L.M.L. ole Lowassari, Mweka College of Wildlife Management
I. Gara, Mweka College of Wildlife Management
M. Madehele, University of Dar es Salaam
S.K.M. Kayungilo, Mweka College of Wildlife Management
M.R. Kiondo, University of Dar es Salaam

Sampling

Transect spacing: 2.5 km.
Total length of transects: 2223 km.
Total area surveyed: 5564 km^2.
Sub-unit length: One minute.
Number of transects: 58.

Nominal flying height: 250 feet.
Nominal flying speed: 150 kph.
Nominal strip width (total) 250m, giving a nominal sample fraction of 10%.

Actual mean flying height: 264 feet, standard deviation 29 feet.
Actual mean flying speed: 156 kph, standard deviation 12 kph.
Actual total strip area: 58335 ha
Actual sample fraction: 10.5%

SURVSUP

Ruaha Ecosystem Wildlife Management Project

Aerial Wildlife Survey in Rift Valley sectors of Ruaha National Park (RNP) and Lunda Mkwambi Game Controlled Area (LMGCA)

Survey No. 1 13th-19th July 1994

Supplementary Notes November 1994

Large mammal distributions

Introduction

The first REWMP aerial survey was conducted in July 1994 and its results reported in October 1994. Since then it has been possible to improve the quality of the large mammal distribution density maps. New maps are attached for the more frequently-recorded species.

Discussion

The new maps confirm the broad distribution pattern suggested in the original report. Most sightings of large mammals occurred inside Ruaha National Park (RNP).

A map is included of combined density distributions of impala, zebra, buffalo, eland and warthog. The distribution is heavily skewed towards RNP. Outside RNP some or all of these species occurred on land within Mlowa and Kisanga village areas, and also on lands in the north east and south-west of Lunda Mkwambi Game Controlled Area. Subsequent surveys will provide further information on animal distributions and support identification of village lands which may have potential for wildlife utilisation.

Ruaha Ecosystem Wildlife Management Project

Aerial Wildlife Survey in Rift Valley sectors of Ruaha National Park (RNP) and Lunda Mkwambi Game Controlled Area (LMGCA)

Survey No. 2 8th-14th November 1994

Summary Report November 1994

Introduction

This report summarises the results of the second REWMP aerial wildlife survey. This survey was conducted in November 1994 as a late dry season count for comparison with the first survey undertaken earlier in the dry season in July (see REWMP Survey No 1 report). The survey area was identical with that covered in the July survey i.e. the Rift Valley segment of Ruaha National Park (RNP) and Lunda Mkwambi Game Controlled Area (LMGCA). The maps indicate the location of the survey area in relation to administrative and physical features.

In the weeks prior to the survey there had been sporadic, localised rain showers in the survey area, which were sufficient to stimulate a flush of leaf in woody plants such as Acacia spp, baobabs, Combretum spp. and various miombo species. In parts of the western half of the survey zone there was widespread temporary surface water in pans and small river courses but in central and eastern parts the environment appeared drier than it had been in July. The Great Ruaha River was dry for much of its course through the survey zone and the water level was low in Mtera Dam at the eastern extreme of the survey zone. Conducted before the onset of any widespread, prolonged rainfall, the survey was a "late dry season survey".

Methods

Survey area and transect location

This survey sampled the same transects flown in the first survey.

Sampling methodology

The survey was conducted using systematic reconnaissance flight (SRF) methodology as described in Norton-Griffiths (1978). The survey parameters are given in Appendix One.

Strips were delineated by streamers fixed to the wing struts. Strip widths were calibrated by flying at various heights over markers spaced 20 meters apart. Regression analysis was performed to estimate for each rear seat observer the relationship between aircraft height and number of markers seen, an estimator of observed strip width.

Sampling was carried out between 0700 and 1000 each day. The pilot located each transect and used the aircraft's Global Positioning System (GPS) to identify the beginning of each 2.5 km sub-unit along the transect. For each sub-unit the rear seat observers (RSOs) recorded on cassette the large mammals sighted. In each sub-unit the front seat observer (FSO) took a reading from the radar altimeter and noted the predominant vegetation type below the aircraft.

Data analysis

Large mammal population estimates were generated using Jolly's method for unequal-sized sampling units as described in Norton Griffiths (1978). SRF software (Campbell), with supplementary programs supplied by TWCM, was used to perform the data analysis and generate density distribution maps for large mammals. This software was also used to generate vegetation community distribution maps based on the FSO observations.

Results - population estimates for this survey

Twenty-two species of wild mammals were recorded during the survey. Population estimates for the more important species are shown below, with figures from the July survey for comparison. Density distribution maps are in Appendix Two.

Animal	Population Estimate November 1994	95% C.I.	Population Estimate July 1994	95% C.I.
buffalo	4283	63%	3306	89%
eland	724	71%	536	83%
elephant	1248	55%	1307	43%
giraffe	2338	12%	2636	11%
impala	3592	34%	4340	21%
kudu	342	45%	596	34%
zebra	3191	26%	3424	28%
livestock *	66411	21%	44581	26%

* livestock - cows, sheep and goats

Combined population estimates for July and November surveys

For the more important species, population estimates from July and November surveys were combined to produce dry season population estimates. Cochran's method was used as described in Norton Griffiths (1978).

Animal	Combined dry season population estimate	95% C.I.
buffalo	3845	51%
elephant	1282	34%
giraffe	2488	8%
impala	4062	18%
zebra	3292	19%

Discussion

Population estimates

There were no statistically significant differences between July and November estimates for populations of wild mammals listed here. The survey suggests that between July and November there has been a statistically significant increase in the livestock population estimate ($d = 2.45$, at $P = 5\%$). This may be due to increased concentration of herders and their stock around the receding waters of Mtera Dam in the east of the survey zone.

Combined dry season population estimates

Combining July and November population estimates provided improved dry season population estimates for major herbivores, but confidence intervals for elephant and buffalo population estimates remain high at 34% and 51% respectively. Norton-Griffiths (1975) was able to generate more precise buffalo and elephant estimates by combining results of wet and dry season counts in RNP. REWMP may be able to use this expedient in the coming wet season, provided that there are no significant changes in populations of these species in the survey area.

Large mammal distribution

The distribution maps in Appendix Two indicate the distribution and relative densities of various large mammal species in the survey area.

Distribution of all wildlife combined was similar to that indicated in July, with the highest areas of wildlife density inside RNP. One feature that appears to have changed since then is an increased occurrence of wildlife outside the park in the south west end of the survey zone. This area is hilly, wooded (miombo) and appears largely uninhabited by humans though there are signs of timber extraction (see also TWCM, 1994). Elephant, sable, giraffe, buffalo and impala were among the species recorded in this area.

The zebra distribution map indicates a shift in density towards the eastern part of the survey zone. This supports previous surveys (e.g. TWCM, 1994) which suggested the zebra population moves west in the dry season and east in the wet season. Results of this survey indicate eastern movement starts after the first showers of rain. Giraffe distribution in November appears to have contracted from its July extent, with an increased concentration of animals in the central part of the survey area. There appears to have been a less pronounced shift of impala distribution away from the west of the survey zone.

Implications for large mammal utilisation

Around villages targeted as potential beneficiaries of the REWMP the situation remains as in July. The village area of Malinzanga/Mlowa appear to support most large mammals, mainly near the RNP boundary. The distribution map for impala, buffalo and hartebeest indicates the distribution of quota species which could be harvested on a pilot basis this year.

It will be interesting to monitor distributions outside RNP in the wet season. After heavy rains areas of LMGCA will be inaccessible to motor vehicles and this plus observance of the closed season for resident hunting may reduce the level of human disturbance in these areas. Will it be possible to relate changes in mammal distribution to such factors?

References

Campbell, K.L.I., 1993, SRF: Systematic Reconnaissance Flight. Software for Aerial Survey Analysis.

Norton-Griffiths, M.,1978, Counting Animals. African Wildlife Foundation. Publication no. 1.

Norton-Griffiths, M., 1975, The numbers and distribution of large mammals in Ruaha National Park, Tanzania. E. Afr. Wildl. J. 1975. **13** 121-140.

TWCM, 1994, Survey Report. Greater Ruaha, 1993.

Appendix One

Detailed survey parameters

Aircraft

Cessna 182 5H-FOR

Crew

Pilot: L. Patterson, ODA
FSO: C. Nahonyo, University of Dar es Salaam

RSOs: S. Jennings, ODA
D. Bayona, RNP

Sampling

Transect spacing: 2.5 km.
Total area surveyed: 5485 km^2.
Sub-unit length: 2.5km
Number of transects: 58.

Nominal flying height: 250 feet.
Nominal flying speed (ground speed): 150 kph.
Nominal strip width (total) 250m, giving a nominal sample fraction of 10%.

Actual average flying height: 275 feet, standard deviation 50 feet
Actual average flying speed (ground speed): 154 kph, standard deviation 13 kph
Actual total strip area: 50778 ha
Actual sample fraction: 10.8%