HOTFIRE WILDLIFE MANAGEMENT MODEL – A CASE STUDY

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Abstract

The Hotfire wildlife and veld management model is a simple tool that is used to predict game numbers on the Hotfire ranch and compare them to estimates made during normal ranching operations. The model consists of a series of interactive Excel workbooks. The basic building blocks of the model are spreadsheets which predict the population growth for each species on the ranch.

Data on veld type and carrying capacity form the basis for spreadsheets used to determine a selected animal load for each species on the ranch. The population growth models are linked to the animal load model in order to compare actual and predicted animal loads with the calculated carrying capacity. The data are used to set annual hunting quotas which are the main management tool for the multi-species continuous grazing production system on the Hotfire properties.

Case histories for two species illustrate the practical use of the model. Blue wildebeest data is used to illustrate how incorrect estimation of the original population statistics can lead to under estimation of predicted population growth and the resulting impact on grazing which required management intervention by adjusting hunting quotas. Observation of kudu numbers compared to the predicted data is used to illustrate the possibility of an influx of kudu bulls onto the property.

Introduction

The Hotfire properties were converted from a livestock to a wildlife farming operation in 2002 as the sweet and mixed veld of the farms had been degraded over time to the extent that livestock farming was

no longer viable. The assumption was made that extensive wildlife ranching could help the veld recover and restore the profitability of the properties. It was, however, recognized that the wildlife would need to be carefully managed if the objectives were to be achieved.

Hotfire, like many privately owned medium sized (2500ha) wildlife ranching operations, has limited working capital. More expensive management tools like regular airborne game counts and management consulting services, although highly desirable, are not an affordable option. The estimation of game numbers using cheaper road and foot counts is difficult as the Hotfire properties are dominated by fairly dense transitional valley bushveld vegetation and the terrain is rugged. The need for a simple management model to predict game numbers and compare these to estimates made by management and staff undertaking normal ranching tasks was recognized and the Hotfire wildlife and veld management model was developed.

Description of the Model

The Hotfire wildlife and veld management model, which comprises a series of interactive Excel worksheets, was based on a consulting report compiled by Dr Deon Furstenburg (2003) and on data presented in a series of descriptions of various antelope species published by Furstenburg in the *Game and Hunt* magazine (e.g. Table 1). Spreadsheets predicting the population growth of each species on the ranch form the basis of the model. They are in turn linked to spreadsheets that estimate the grazing load on the ranch for each year and compare this to recommended carrying capacity.

Characteristic	Bull		Cow
Social maturity	5 years		2.5 years
First calf			3.5 years
Calving interval			10 to 18 months
Weaning age			8 months
Sex ratio population (natural)	1 Bull	to	1.2 Cows
Sex ratio pop. (production)	1 Bull	to	4 Cows
Annual population growth		30% average (28% to 33%)	
Large Stock Unit	0.6 LSU		0.4 LSU
Browser Unit	0 BU		0 BU
Maximum animal density		15ha/animal	

Table 1: Blue wildebeest statistics from Furstenburg, *Game & Hunt* (July 2002)

Population Growth Spreadsheets

Population growth for most game species shows a sigmoid curve when the number of animals in a population is plotted against time (Bothma and Du Toit, 2010). This is illustrated by data for a theoretical impala population plotted in Figure 1. The growth of the introduced population is initially slow but gradually increases until an optimum population growth rate is achieved. Population growth slows as animal numbers approach the ecological carrying capacity of the property.

The ***growth rate*** of the population varies for different species and the optimum population growth rate of a particular species is influenced by variations in habitat conditions. The sex and age composition of the population also has an important influence on the population growth rate. The growth rate applied to predict the growth of a species population is thus very difficult to establish accurately.

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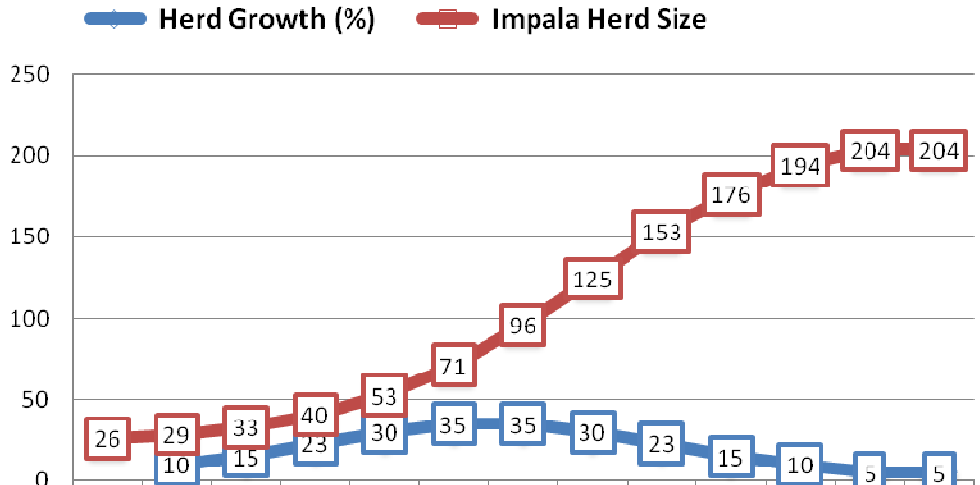
Figure 1. Theoretical Growth of an Impala Herd



	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
Herd Growth (%)		10	15	23	30	35	35	30	23	15	10	5	5
Impala Herd Size	26	29	33	40	53	71	96	125	153	176	194	204	204

The Hotfire population spreadsheets (e.g. Table 2) use the annual total population growth rates published by Furstenburg (*Game and Hunt*, various issues) as a guide. The spreadsheets are used interactively and growth rates can be altered to adjust population estimates to fit any observed data. The temptation to constantly alter the models should be avoided and changes should only be made if evidence from observed data is very compelling. It is often best to keep the original and work on a copy in order to monitor developing trends

The ***population demographics*** (i.e. the sex and age distribution of the animal population) tend towards a natural distribution in large populations such as those on large wildlife reserves. Smaller populations on small and medium sized wildlife ranches can, however, easily be distorted by hunting. The ratio of mature bulls to females, for example, can be distorted if only trophy animals are hunted and this can lead to a drop in population growth and quality. The total population growth figures which are generally used can thus be unreliable on smaller hunting ranches. The Hotfire management model spreadsheets thus also attempt to predict the population demographics by modelling based on the number of mature females and a calving/lambing percentage (Table 2). Field observations of the number of calves/lambs are therefore very important.

The ***hunting quota*** is the most important management tool on the Hotfire wildlife ranch. The growth rate and demographics of wildlife populations are the key factors in establishing annual hunting quotas. The objective is to keep the species population numbers such that the population demographics ensure that the annual population growth rate is close to the optimum number and that the total population remains at the selected optimum number for the property

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Growth rate (% of herd)		23	23	23	23	25	25	25	25	24	23	22	22
Estimated Population	38	45	53	61	68	72	79	87	96	103	111	117	124
Harvest cows	0	1	1	2	5	7	5	5	7	8	8	8	8
Harvest bulls	0	0	0	0	1	2	2	3	2	4	4	5	6
Harvest mature bulls	0	1	1	2	1	4	4	4	4	4	4	5	5
Total Quota	0	2	2	4	7	13	11	12	13	16	16	18	19

Table 2: Original population growth spreadsheet for blue wildebeest

Blue Wildebeest Case History

Blue wildebeest were the first species introduced on the Hotfire ranch and the wildlife management model had not been fully developed at that stage. The actual number of bulls and cows, as well as an estimate of the number of animals in each age group, was not recorded. Spreadsheets predicting the blue wildebeest population were thus based on the original total number of animals introduced (Table 2).

Observations by ranch employees and hunting groups during the 2009 season indicated that the model was under estimating the total number of blue wildebeest on the property. A count of blue wildebeest done in February 2010, with the help of members of the Transkei Hunting and Shooting Association, indicated a conservative estimate of 125 animals. The original model indicated a population of 99 blue wildebeest (i.e. 87 animals at the end of the hunting season plus a quota of 12 animals as shown in Table 2). Hunters also noted that there appeared to be more mature bulls than the model indicated. The conclusion was reached that the original model had under estimated overall population growth and that the original estimate of population demographics had been incorrect. A revised model (Table 3) was compiled.

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Growth rate (% of herd)		28	33	33	28	23	23	23	23	23	23	23	20
Estimated Population	38	47	61	78	90	98	102	111	118	125	127	121	113
Harvest cows	0	1	1	2	5	7	4	3	12	14	16	18	20
Harvest bulls	0	0	0	0	1	2	6	5	4	5	5	7	7
Harvest mature bulls	0	1	1	2	1	4	7	6	5	5	5	6	7
Total Quota	0	2	2	4	7	13	17	14	21	24	26	31	34
Calving Rate (% of Cows)		80	85	85	85	85	85	75	75	80	80	80	80
Calves		11	15	20	19	20	22	23	26	30	28	25	22
1yr & 2yr Cows	12	6	6	13	17	18	19	20	20	22	25	25	21
Mature Cows	14	19	24	23	24	25	30	31	38	35	31	28	23
1yr & 2yr Bulls	6	3	6	14	18	19	17	17	21	23	27	26	23
3yr & 4yr Bulls	4	4	5	2	4	10	9	9	8	10	11	11	13
Mature Bulls	2	4	5	6	8	6	5	5	5	5	5	6	6

Table 3: Revised population growth spreadsheet for blue wildebeest (February, 2010)

Grazing and carrying capacity models for the ranch indicate that blue wildebeest numbers should be maintained between 80 and 100 animals. The annual hunting quota was thus adjusted and it was decided

to drastically increase the number of cows to be harvested each year in order to stop the growth of the herd.

Kudu and Hartebeest Populations

Kudu were introduced onto the Hotfire properties in 2006. Observations during 2009 and 2010 indicated that there were more kudu bulls on the ranch than predicted by the population growth model. The computer model numbers could be adjusted by assuming better than average population growth rates, but this did not adequately explain the presence of more old bulls than predicted. It is possible that there were more free roaming kudu on the properties before the introduction of the breeding herd, but even allowing for an original herd of 16 animals (observations before 2006 had indicated half this number) does not seem to explain the number of "large" bulls seen by hunters. The anomaly may indicate an influx of free roaming kudu bulls attracted by the relatively large number of cows introduced onto the ranch. Farmers with fenced lucerne lands know that large kudu bulls have little respect for 2.4 metre game fences.

Observations of the hartebeest numbers on the properties show a negative deviation from the computer model. The estimated numbers indicate a very low growth rate which may be ascribed to high natural deaths. This is supported by a more than expected number of horns picked up in the veld. The reason is uncertain but could be a combination of a large number of old animals in the introduced breeding herd and a susceptibility to tick-borne diseases.

Conclusion

Using a computer model to predict animal numbers on a game ranch may be viewed by some as a case of "measuring with a micrometer, marking with chalk and cutting with an axe". Management at Hotfire have, however, found that the computer models, even if their accuracy can be questioned, help to focus attention on potential problems. The models have proved very important for determining sustainable hunting quotas.

References

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