Production parameters of the impala, *Aepyceros melampus*

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From a game farming point of view, the impala is quantitatively the most important animal in the Bushveld areas of South Africa. However very little published data are avaialable on the productive capacity of this animal. In a long-term study of the impala in the Kruger National Park, certain production parameters have become available that can be used to evaluate the game-farming potential of this animal. Mean life-expectancy at birth is 2,6 years under natural conditions, with 64 per cent of those born entering the second year of life, but only 12 percent entering the sixth year. The sex ratio at birth is equal but at maturity it is skewed toward the female segment *viz.* 65 per cent. Reproduction is very strictly seasonal, with a mean conception date on 10th May and a standard deviation of ± 22 days. The ewe has a maximum of two cycles in this period, but usually conceives at the first oestrus. Fecundity is 90–95 per cent in mature females, but lower in two-year-old ewes and is influenced by climate. No sign of reproductive senility has been found in animals of up to 12 years. Growth is rapid and asymptotic mass is achieved at 5 years. Dressed mass, is 53 per cent of warm carcass mass, at 9 months and 57 per cent at 24 months and older. The better cuts make up a large proportion of the impala carcass and the meat is lean, having almost no visible fat.

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Uit 'n wildboerdery oogpunt, is die rooibok getalsgewyse die belangrikste dier in die bosveldgebiede van Suid-Afrika. Min gepubliseerde gegewens omtrent die produksievermoë van dié bok is egter beskikbaar. 'n Langtermynstudie van die rooibok in die Nasionale Kruger Wildtuin, het sekere waardes uitgebring wat gebruik kan word om die dier se wildboerdery potensiaal te evalueer. Gemiddelde lewensverwagting by geboorte is 2,6 jaar. 64 Persent bereik die aanvang van hulle tweede lewensjaar, maar slegs 12 persent bereik hul sesde jaar. Die geslagsverhouding by geboorte is gelyk, maar by die ouer bevolking is dit ongelyk, met 65 persent vroulike diere. Voortplanting is streng volgens seisoen met 'n gemiddelde bevrugtingsdatum van 10 Mei en 'n standaard afwyking van ± 22 dae. Die ooi het hoogstens twee oestrus periodes in een seisoen, maar word gewoonlik tydens die eerste periode bevrug. Vrugbaarheid is 90–95 persent in volwasse ooie, maar laer in tweejarige ooie en word deur klimaat beïnvloed. Geen teken van voortplantingseniliteit is gevind tot 'n ouderdom van 12 jaar nie. Skoongemaakte karkasmassa is 53 persent van warm karkasmassa op nege maande en 57 persent op 24 maande en ouer. Die beter snitte bevat 'n groot gedeelte van die karkas.

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Introduction

Game meat obtained from the cropping of wild populations has been used by man since time immemorial. Since the pioneering work of the Americans Dasmann & Mossman (1960), the concept of using the African ungulate fuana for game-farming, has become established, but has to date not been properly evaluated. Some of the recommendations for this type of farming are still based on wrong premises due to a lack of basic data of importance in the planning of this enterprise.

The impala *Aepyceros melampus* is numerically the most important single species available for game farming in the Lowveld and bushveld areas of the Transvaal and northern Natal. Research carried out over the past decade has established certain production traits of natural populations of impala and this information forms the basis of this paper.

Methods

Natural populations in the Kruger National Park and the adjacent Sabi Sand Private Nature Reserve, in the Republic of South Africa were investigated. Here impala are exposed to a relatively natural environment and to predation by the full range of large predators. Age and sex ratios were determined by differential counts of 11 000 impala and from shot samples (1323 impala) obtained during culling operations. Age of the mature segment was determined by using the eyelens technique (Fairall, 1969). These data were used to draw up a life-table to evaluate age structure, and from this, optimal cropping schedules, using methods commonly used in fisheries biology (Ricker, 1975).

Most of the material for the work reported here, was collected using a monthly sample of five male and five female impala from 1962 to 1969, a period of lower than average rainfall (Table 1). For studies of reproductive physiology, the methods of Fairall (1971) were followed, using 420 animals of each sex. The method of Caughley (1977) was used to determine the mean date of conception, and the extent of the mating season was estimated from data obtained by ageing foetuses, collected during culling operations (Fairall, 1969a).

Growth was recorded as body-mass and is presented in the form of the theoretical Von Bertalanffy growth curve (Von Bertalanffy, 1938). It illustrates the concepts of

Table 1 Total rainfall at Skukuza in the center of the study area, with a subjective evaluation of its effectivity

Year	Rainfall (mm)	Effectivity
1962	350	Poor
1963	437	Poor
1964	433	Good
1965	343	Good
1966	575	Good
1967	547	Reasonable
1968	413	Reasonable
1969	568	Reasonable

Forty-two year rainfall mean 571,5 mm.

exponential growth and attainment of asymptotic mass more clearly than the raw data.

The carcass composition of fifteen impala, shot during the study, were analysed following the methods outlined by Ledger (1963). Fat extraction from samples of the longissimus dorsi muscles of these carcasses was accomplished by refluxing with chloroform. Feeding habits were investigated by examining the percentage of grass and browse in three 100 ml aliquots of rumen content taken monthly from three impala for one year. Only the macroscopically identifiable fragments were used.

Results

Sex ratio at birth is even (51,9 per cent females out of 765 foetuses), but in the mature population it is skewed (65% female). Details of the age structure of the population and the life-table are given by Fairall (1969). Of interest here, is that mean life expectancy at birth is 2,6 years, 64% of those born entering their second year of life but only 12% surviving to the sixth year.

Breeding is strictly seasonal with a mean date of conception at 10 May and a standard deviation (SD) of 22 days for the whole study period, although this varies from year to year (Table 2). This variation can be ascribed to climate with rainfall having the greatest influence via the vegetation (Figure 1).

The impala ewe has a maximum of two oestrous cycles annually, as determined on four ewes running with vasectomized rams, but ovarian histology indicated that most conceive during the first cycle. Only two cases of missed conception were recorded (as corpora lutea without con-

Table 2 Mean dates of conception calculated for impala during the study period

Year	n	Mean date	Sd (days)
1966	264	21 May	± 9,1
1967	124	12 May	± 6,5
1968	101	14 May	±14,1
1969	312	17 May	± 3,2
Combined	801	10 May	±21,95

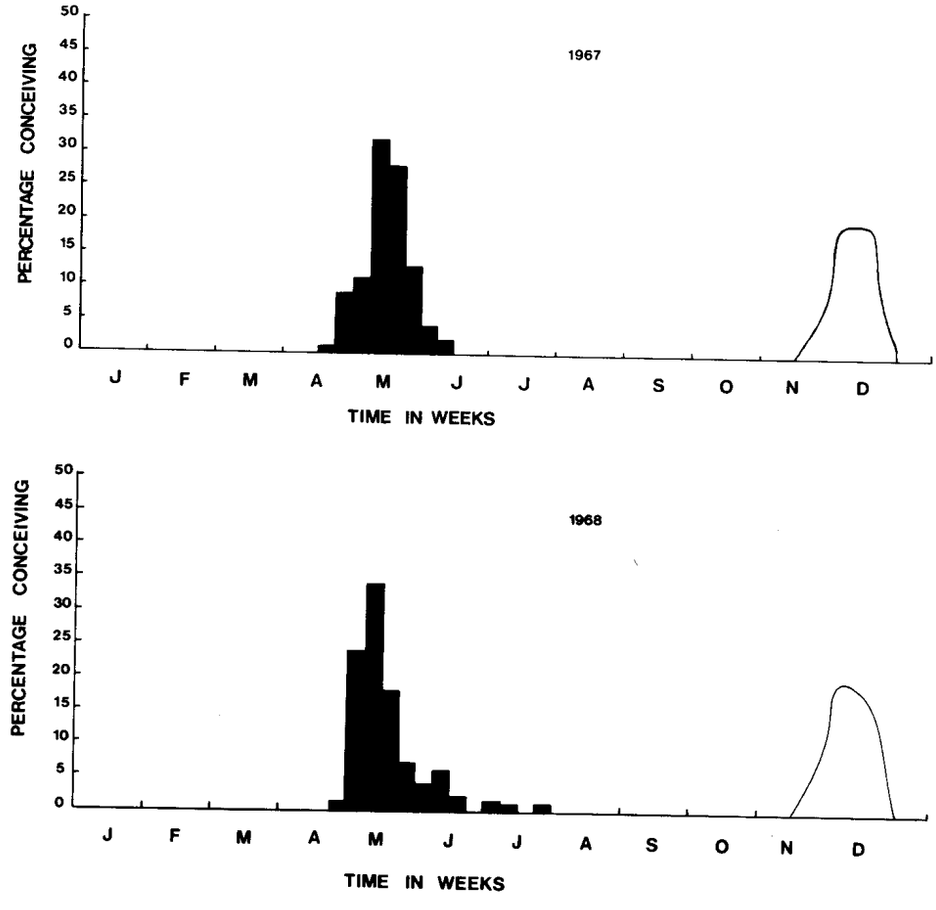

Figure 1 The breeding season illustrated in terms of numbers of ewes conceiving, showing late conceptions in 1968.

ceptusses) in the 420 ewes examined, both of these occurred during 1965, the mid-point of the worst drought in the Lowveld this century.

Fecundity averages 95% in mature females (2 years+) but is lower and more variable in two year-olds (Table 3). No indication of reproductive senility was found in 860 females examined during the present study. The oldest ewe included was estimated to be twelve years old.

Growth rate, while not as fast as that of domestic sheep, is high (Figure 2) and the asymptotic mass is achieved at an age of five years, but 75% of mature mass is achieved by two years of age. Mature mass in this population was 49,2 ± 1,02 kg in males and 38,3 ± 1,79 kg in females. The carcass characteristics of the impala are summarised in Table 4. The dressing percentage is 57%, while the relative mass of hindleg and foreleg compared to the neck and rib-cage, shows that the better cuts make up a large proportion of the carcass. While impala in good condition have free intestinal fat deposits, the carcass rarely has any visible fat, and fat extraction of the logissimus muscle gave mean values of 2,8% fat in nine-month-old impala, 4% in the two-year-olds and 3% in the mature animals.

The feeding information in Table 5 confirms that the impala is a browser/grazer, feeding almost exclusively on young grass in the spring and early summer. They make more use of dicotyledons as the grass matures until they feed almost exclusively on browse during the winter.

Using the above data, certain calculations can be made that further illustrate the productivity of the impala. Given the fecundity rate and mean life expectation, the number of animals added to the population, after all

Table 3 Fecundity in impala as determined in this study

	Mature females		Two year old females	
Year	n	Percentage pregnant	n	Percentage pregnant
1962	30	90,0	12	0,0
1963	60	90,0	6	16,8
1964	22	77,2	2	50,0
1965	72	82,0	7	71,5
1966	36	98,2	3	33,3
1967	247	95,1	36	58,3
1968	79	94,0	38	87,0
1969	274	98,2	48	62,5

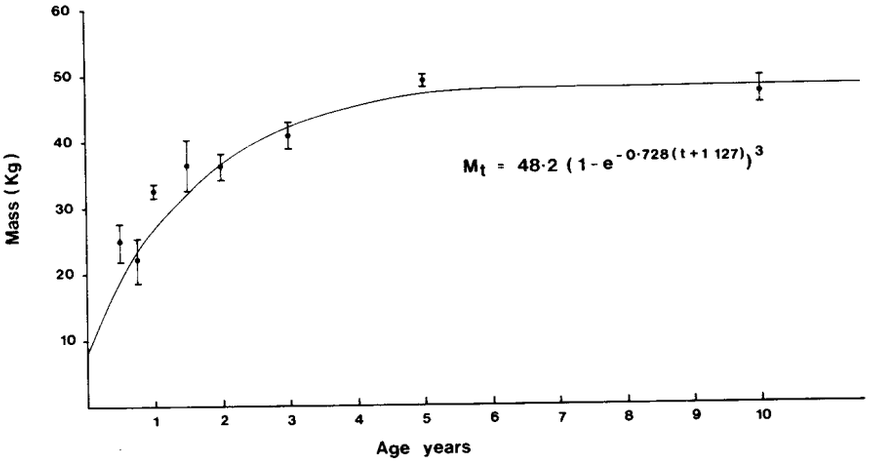

Figure 2 Von Bertalanffy growth curve for the male impala.

Table 4 Mean carcass composition of five male impala in each of three different age groups

Age	n	Shot mass kg	Carcass %	Dressing %	Hindleg kg	Foreleg kg	Neck, thorax and loin kg
9 months	5	19,1	10,2	53,1	2,3	1,4	1,6
24 months	5	38,5	22,0	57,1	5,0	2,7	4,4
Mature	5	49,4	28,1	56,9	6,1	3,3	4,7

Table 5 Mean percentage browse in the impala diet throughout the year and maximum amounts found in any one rumen

% Browse	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Mean	25	27	30	75	76	82	55	63	52	78	21	15
Max	42	30	40	85	96	98	100	65	52	98	51	50

decimating factors have taken their toll, can be calculated from strength of cohort × fertility rate × mean expectation of life. The fertility rate can be taken as 0,94 (Table 3) therefore a cohort of 100 females will have 244 lambs in their lifetime of which 50% will be male. There is thus an addition of 22% of the female segment, or conversely, 22% of the females can be cropped to keep the population constant. The impala can lamb for the first time at two years of age and at this stage 45% of the mortality has occurred. It is also apparent from Figure 2 that the growth increments are small after two years. Cropping should therefore be done before mortality takes a further toll. Calculated yield per recruit, if cropping commences at two years of age, using the method of Ricker (1975), gives a value of 41,8 kg per male and 36,9 kg per female assuming a life expectancy at birth of 2,6 years as was found for this population. Taken at a calculated cropping rate of 22% this provides 865 kg shot mass per 100 impala, or at a dressing percentage of 57%, 493 kg carcass mass.

Discussion

When considering the productivity of impala, it is pertinent to ask whether they can perform any role in agriculture. If not, they are hardly worth further consideration. One argument for game farming is that multiple-species use enhances productivity. Walker (1979) points out that this concept does not hold in absolute terms. In the impala, however, the use of browse, as shown in Table 5 and confirmed by Monro (1980) and Dunham (1982) in an area where a large proportion of the plant biomass is woody vegetation, indicates their possible value in combination with cattle, which are almost exclusively grazers. This is also emphasized by Taylor & Walker (1978) in a study of vegetation use on a combined cattle and game enterprise in Rhodesia.

The consistently high fecundity under adverse conditions, provides the basis for a high cropping rate (22%), even under a predator regime in which large predators such as lions, leopards, wild dogs and spotted hyaenas remove a substantial, although quantitatively indeterminable number of the population (Pienaar, 1969). Extrapolation to a farming situation without predators is not possible but a 25–30% crop, as suggested by Dasmann & Mossman (1962), seems reasonable.

Another way of evaluating the productivity of this impala population is on the basis of the equilibrium yield per recruit (Ricker, 1975). This is calculated by integrating growth and mortality over that portion of the lifespan where the impala are vulnerable. Under stable conditions, this is equal to the yield during one year from all age classes (Paulik & Bayliff, 1967). It was shown that this yield would be 41,8 kg per male recruit and 36,9 kg per female if entry to the exploitable population is taken at two years of age. The mean mass of the impala in this population at two years of age was actually determined as 36,7 ± 1,7 kg for males and 34,5 ± 1,33 kg for females, these figures therefore correspond quite closely.

The dressing percentage found in the present study, though lower than that given by Van Zyl, Von La Chevallerie & Skinner (1969) for the impala, is better than any equivalent sized antelope quoted by Von La Chevallerie (1972), and obviously enhances the productivity in terms of saleable product. Although meat quality was not studied in this investigation, it has been discussed by Von La Chevallerie (1972) and corresponds closely to that of the major ungulate species used for game farming.

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