THE USE OF THE EYE LENS TECHNIQUE IN DERIVING THE AGE STRUCTURE AND LIFE TABLE OF AN IMPALA (Aepyceros melampus) POPULATION

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INTRODUCTION

Very few studies on the population dynamics of African mammals hav been undertaken. Less has been done on the derivation of data fror accurate population age structures.

The age structure of an animal population in the natural state forms basis from which life tables can be compiled as it presents a picture c the survival of each age class which has been exposed to the decimatin effects acting on the population as a whole.

Life tables can be used to monitor the ability of a population to maintai itself, to predict the allowable crop and to estimate the effects of exploitc tion (Quick, 1963).

In the Kruger National Park culling of certain impala populations hc been instituted. It is therefore essential to have a life table available i order to ensure that the natural population structure is not disrupted.

TECHNIQUES

The age strcture was obtained by the following methods:

1. The young of the year group (lambs) was calculated from a lambin persentage of 90% for mature females and 50% for 2 year olds. The figures were obtained from unpublished studies in which 300 ewes hav been used.

2. The yearling and two year old groups were determined by differe tial counts in which 11,000 impala were classified.

3. All animals 3 years and older were taken as being mature ar their age group composition was determined by the eye lens study. It wa assumed that mature impala of all ages were shot at random without bi towards any particular age group, since their ages cannot be determined the field.

THE EYE LENS TECHNIQUE

The technique has been described by Lord (1959) and was applied as follows:

(1) Eyeballs were excised and after injection with 10% formalin were fixed in formalin for at least one week.

(2) Lenses were carefully removed and dried to a constant weight. This was normally achieved after 7-10 days.

(3) Lenses removed from the oven were cooled in a dessicator over silica gel and weighed on an electrical balance.

A standard age/lens weight curve was compiled by obtaining the average lens weight of between 20 and 50 animals a month for a period of 24 months. This was possible as the impala has a restricted breeding season and the animals can be accurately aged up to two years. These weights were plotted on a graph of lens weight against age. The weight from 10 known age three year olds, one $3\frac{1}{2}$ year old and one $4\frac{1}{2}$ year old animal were also plotted.

The physiological age limit was taken to be 12 years as this is the oldest age cited in the literature (Child, 1964). The heaviest lens weight encountered was taken as that of a 12 year old and this formed the end point of the graph. This curve is presented in Fig. I and from it the range in weight for each age class was determined. The lenses of the mature animals were allocated to these age classes to determine the proportional strength of each class.

This information, combined with the previously described groups, and worked to a base of 1,000 animals gave the survival curve presented in Fig. 2.

RESULTS

Three types of life tables may be constructed: dynamic, time specific and composite. The first describes a specific group or cohort from birth until the last individual dies. The second makes use of samples of the different age groups, whilst the composite life table derives from the ages of animals at death regardless of their year of birth.

The life table presented in Table 1 is time specific, it reflects the age groups in the population in one specific year and is derived from the survival data previously presented, following the methods outlined by Quick (1963).

In applying the results of life table analysis to population management, it is necessary to have a clear picture of the management objectives.

In the Kruger National Park, the primary objective is the maintenance of a balance between the number of animals and the basic resources of

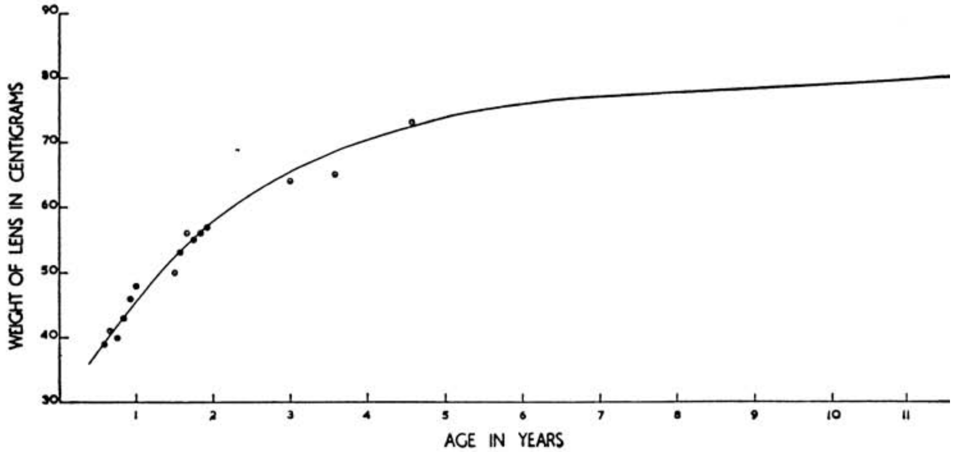

Fig. 1. *Lens weight age curve of impala.*

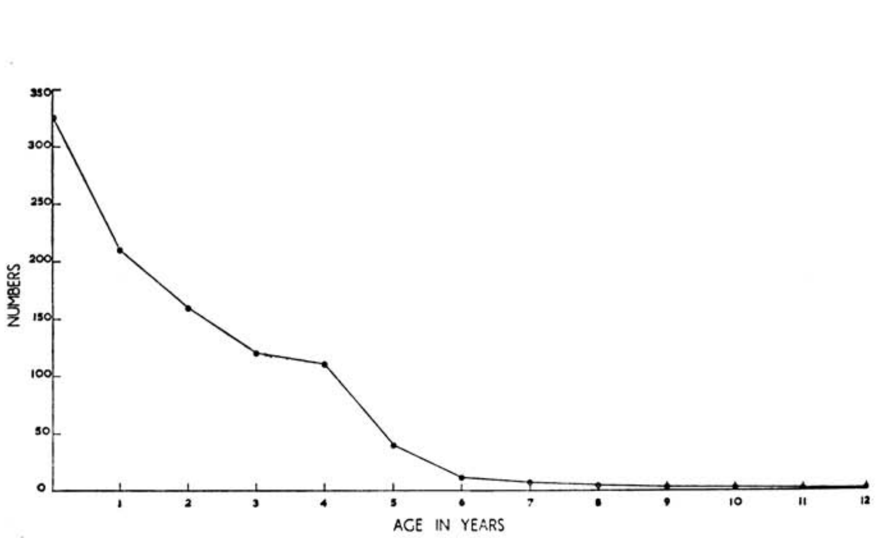

Fig. 2. *Age structure of an impala population of 1,000 animals.*

the habitat. This entails the control of numbers to keep the population stable and in some cases the preliminary reduction of the population before stabilizing it.

A secondary objective is to create as little disturbance as possible to the natural population structure.

To attain the first objective it is necessary to know the productivity of the population. This is the number of animals added to the population per year after all decimating factors have taken their toll.

This figure can be estimated by applying the following formula of Quick (1963): Strength of Cohort × fertility rate × mean expectation of life = number of young.

The fertility rate of this population can be taken as 0.8 and the mean life expectancy as seen in the life table is 2.6 years. A cohort of 1,000 female animals will thus have 2,080 lambs in their life span of which 50% will be male. There is thus an addition of 4% to the female segment of the population per year.

TABLE 1.

Life Table of Impala Population.

Age class. x	*Number dead in age class.* d'x	*Number of deaths per thousand.* dx	*Number of survivors per thousand.* 1x	*Death rate per thousand in age class.* qx	*Mean number of individuals alive between age classes.* Lx	*Mean expectation of life.* ex
1	117	358	1000	358	821.0	2.6
2	50	175	642	272	554.5	2.7
3	40	100	467	214	417.0	2.5
4	10	1	367	2	366.5	2.1
5	69	241	366	658	245.5	1.1
6	27	83	125	664	83.5	1.3
7	5	15	42	357	34.5	1.9
8	5	15	27	555	19.5	1.6
9	2	6	12	500	9.0	2.0
10	0	0	6	0	6.0	2.5
11	1	3	6	500	4.5	1.5
12	0	0	3	0	3.0	1.5
13	1	3	3	1000	1.5	0.5

On the population as a whole a crop of 8% will keep the condition static. This figure seems to be low and it may be due to the fact that these data derive from a population that has been subjected to four years of drought, which would have influenced both fertility rate and mean expectation of life. Further research will probably result in a higher figure.

The second objective can be obtained by routine monitoring of the animals that are being cropped and by applying the ratios obtained in the age structure study to the number of animals that can be killed per year.

DISCUSSION

THE EYE LENS TECHNIQUE

The technique was originally described by Lord (1959) for cottontail rabbits. Since this time it has been applied by a number of other workers to a variety of mammalian forms. These were mainly small animals such as gray fox (Lord, 1961), raccoon (Sanderson, 1961), swamp rabbits (Martison et al, 1961), rabbits (Dudzinski and Mykytowycz, 1961), fox squirrels (Beale, 1962) and cottontail rabbits (Wright and Conway, 1962).

It has also been applied to larger mammals such as pronghorn antelope (Kolenosky and Miller, 1962), white tailed deer (Lord, 1962), and the fur seal (Bauer et al, 1964), while Longhurst (1964) evaluated the use of this technique for aging black tailed deer. Grafton (1965) did the same for the impala while Laws (1967) investigated lens growth in the African elephant.

It appears that the technique is accurate for small, fast growing mammals with a restricted lifespan, as well as in the young, fast growing stages of the larger mammals. It becomes less accurate in the older animals as the gain in lens weight per year is often smaller than the overlap between weight classes.

A study of the frequency distribution of the 889 lenses in the mature group was strongly indicative of age grouping and a progressive increase in weight in the older groups. This is borne out by the literature where for species as divergent as the pronghorn antelope, black tailed deer, fur seal and African elephant the heaviest weights were always obtained from the oldest animals. In contrast Grafton (1965) finds that this does not apply to impala older than 18 months.

Longhurst (1964), in his study of black tailed deer, found that there was a significant difference between the weights of male and female eye lenses. In the present study no such distinction could be made owing to the small numbers of known age animals and the consequent difficulty in deriving two lens weight age curves. Both sexes were therefore pooled in all calculations.

Although there is a tendency for a progressive increase in lens weight the placing of specific animals in age classes is not accurate after four years. In the present study 889 animals were aged according to the lens technique and it is felt that with a sample of this size the age class averages would be accurate enough to overcome the overlap inherent in the older groups.

THE LIFE TABLE

The life table presented is time specific and it therefore assumes that all age classes are equally represented initially and that all cohorts have been equally influenced by the decimating factors acting on a natural population. This obviously might not be correct as the population in question had been affected by a drought of four years duration.

The assumption was initially made that the sex ratio is even. In our case, as well as in the literature (Mossman and Dasmann, 1962; Stewart and Stewart, 1966), the females are usually more numerous than males. Accordingly the rate of removal calculated from these data must be expected to be too low.

SUMMARY

This paper reports a study of the age structure of an impala population where 889 mature animals were aged by the eye lens technique, the younger age classes being determined from differential counts on 11,000 animals.

The eye lens technique entails fixing, drying and weighing of the lenses and subsequently comparing the weights with a standard age-weight curve.

A life table derived from these data is presented and discussed in relation to yield prediction and population stability where a cropping programme is to be introduced.

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