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Regional differences in growth parameters between two impala populations

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Abstract

The origin of differences in growth parameters between impala from the Mara Research Station (Mara) and the Messina Experimental Farm (Messina) was investigated. Impala from both localities were harvested, and body weights (BW) and cold carcass weights (CCW) were measured. The impala were classified into three age classes, young, sub-adult and adult. In all age classes and for both sexes BW, CCW and dressing percentage (Dres%) were higher at Mara than at Messina. The ratio between actual BW and mature body weight (RBW) was similar for animals in the young age class, but was higher for animals from the sub-adult class at Mara compared to sub-adults from Messina. Differences in the genetic composition or parasitic infestation are highly unlikely to be the causes of the differences in the growth parameters between the two sites. Seasonal effects in forage supply could not be determined. The results suggest that differences in the growth parameters between animals from Mara and Messina were mainly due to differences in maternal effects (pre-weaning) and differences in the nutritional environment (post-weaning).

Keywords: *Aepyceros melampus*, body weight, carcass weight, game, growth
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Introduction

The work of Child (1964) provided the impetus for studies characterizing the growth and development of impala (*Aepyceros melampus*). Growth and development of impala received wide attention especially between 1974 and 1985. Most of these studies only characterized the growth of impala at specific locations, including the Sengwa Research Area (Hanks *et al*., 1966), the Wankie National Park (Howells & Hanks, 1975), the Kruger National Park (Fairall & Braack, 1976; Fairall, 1982) and the Mkuzi Game Reserve (Brooks, 1978). Since 1980 research focused on nutritional (Skinner *et al*., 1984), carcass (Dunham & Murray, 1982; Van Zyl & Ferreira, 2004) and meat (Kritzinger, 2002; Kohn *et al*., 2005) aspects.

Only Anderson (1982) endeavoured to compare the growth rates of impala at different localities, and speculated that differences in the nutritional environment and parasitic infestation might be responsible for differences in growth rates at different localities. More recently the study of Kritzinger (2002) revisited the topic of regional differences in the growth rates and body weights of impala from different environments. Although both authors mentioned nutrition as a factor contributing to differential growth rates in different regions, they did not indicate if the effect of nutrition could be due to year round differences in quantity and/or quality of the grazing, or whether nutrition limited growth rates only during a specific season. The possibility also exists that these reported differences could be due to differences in climatic environment, nutritional environment, maternal effects as well as genetic differences between populations from different localities. The aim of this study is to establish the origin of these differences in growth rates of impala.

Materials and Methods

Impala were harvested at Mara Research Station (Mara) and Messina Experimental Farm (Messina) from May 2001 to November 2002. At Mara the long term mean annual rainfall (July to June) is 450 mm while at Messina it is 350 mm. Mara is situated in the Arid Sweet Bushveld (Accocks, 1980) and Messina in the Mopane veld (Accocks, 1988). At Mara the woody component of the veld consists to a large extent of

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leguminous *Acacia tortilis* trees, while at Messina it consists mainly of dense stands of *Colespermum mopane* trees. Perennial grasses such as *Panicum maximum, Panicum coloratum, Digitaria eriantha* and *Urochloa mosambiscensis* are abundant at Mara, while annual grass species such as *Aristida* spp., *Eneapogon* spp. *and Schmidtia pappaphoriodes* are ubiquitous at Messina.

At Mara 113 impala were harvested using .30 calibre rifles. At Messina 393 impala were harvested using calibres ranging from .223 to .416 Rigby. Most of the animals harvested at Mara were killed with a shot to the neck or head, while at Messina most animals were killed with a shot though the vital organs in the thoracic cavity. At both locations the animals were exsanguinated in the veld immediately after death. All carcasses were then transported to the respective central processing facilities where all the measurements were taken and the animals were slaughtered according to standard South African practices (Hoffman, 2000).

Body weights (BW) of the animals before processing and cold carcass weights (CCW) 24 hours *post mortem* were recorded. Animals were classified into three age classes namely, young (7 to 10 months old), sub-adult (19 to 34 months old) or adult (> 30 months of age). Age classification was based on the number of visible permanent incisors assisted by the length and shape of the horns in the case of males. The BW and CCW of all animals in the young age class were expressed relative to the mean BW and mean CCW of the adult animals (RBW and RCCW), respectively. Dressing percentage (RDres%) was calculated as Dres%/BW for each individual.

Data was analysed within age groups using the ANOVA analysis of the GLM procedure of SAS (SAS, 1999). Locality, sex, age and month were included as the main effects.

Results and Discussion

The BW of young males from Mara tended (P = 0.057) to be heavier than that of young males from Messina (Table 1). Animals from Mara were heavier (P < 0.05) and had heavier (P < 0.01) carcasses than animals from Messina, regardless of the age and sex class. Except for sub-adult females, animals from Mara had a higher (P < 0.05) Dres% than animals from Messina.

Table 1 Least square means (± s.e.) for body weight (BW), cold carcass weight (CCW) and dressing percentage (Dres%) of impala harvested from the Mara Research Station and the Messina Experimental Farm

Age classes	Sex	Site	n	BW (kg)	P	CCW (kg)	P	Dres% (%)	P
Young (7-10 months)	Male	Mara	5	31.0 ± 1.1	NS	20.0 ± 1.1	**	64.2 ± 1.7	***
		Messina	23	27.0 ± 0.9		15.8 ± 0.6		58.3 ± 0.6	
	Female	Mara	7	27.7 ± 1.3	*	17.8 ± 0.8	**	64.2 ± 1.1	***
		Messina	9	23.6± 1.1		13.5 ± 0.9		56.8 ± 1.6	
Sub-adult (19-34 months)	Male	Mara	24	46.9 ± 1.3	***	28.5 ± 0.8	***	60.9 ± 0.8	*
		Messina	55	38.1 ± 0.6		22.6 ± 0.4		59.2 ± 0.4	
	Female	Mara	9	43.7 ± 1.2	***	26.1 ± 0.9	***	59.7 ± 0.9	NS
		Messina	32	33.3 ± 0.7		19.4 ± 0.5		58.5 ± 0.8	
Adult (>34 months)	Male	Mara	41	61.8 ± 1.0	***	38.5 ± 0.9	***	62.3 ± 0.8	***
		Messina	159	52.9 ± 0.5		31.1 ± 0.3		58.8 ± 0.3	
	Female	Mara	27	48.4 ± 0.8	***	29.8 ± 0.6	***	61.6 ± 1.0	***
		Messina	113	41.2 ± 0.4		24.0 ± 0.3		57.9 ± 0.4	

NS = Not significant, * = P < 0.05, ** = P < 0.01, *** = P < 0.001

Variation in growth parameters has been widely reported. Fairall & Braack (1976) and Anderson (1982) reported BW for male and female impala from the Kruger National Park at the respective age classes that were similar to that measured at Messina. Monro & Skinner (1979), however, reported BW (57.2 kg) for adult impala harvested in the former Northern Transvaal that is intermediate to BW at Mara and Messina.

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Von la Chevallerie (1970) cited various authors that reported similar BW and CCW for adult male impala to that of animals from Mara, while the BW of adult females were intermediate to that of females from Mara and Messina. From the literature reviewed it seems as if impala from Mara represent the upper, and those from Messina the lower ranges in terms of BW and CCW.

The Dres% ranged from 57 % (Van Zyl *et al*., 1969; Fairall, 1983) to *ca*. 66 % (Von la Chevalerie, 1970; Van Zyl & Ferreira, 2004). Internal organs were not weighed in the present study, and Kritzinger (2002) reported only the weight of the empty digestive tract. It can thus only be speculated that the large differences in Dres% was probably due to a combination of factors including differences in conformation and gut fill due to differences nutritional environments. The data in Table 1 suggest that maternal effects played a role in instituting the differences in pre-weaning growth rates and BW between animals raised at Mara and Messina.

The RCCW (Table 2) were similar for animals from Mara and Messina for all age and sex classes. Although RBW of young animals were similar for both sexes at both sites, RBW was significantly ($P < 0.05$) higher for sub-adults at Mara than at Messina. RDres% followed the same pattern than RBW except that RDres was significantly ($P < 0.001$) higher for animals from Messina than from Mara.

The RBW suggest that adult BW are reached at different ages. This indicates that some genetic differences also exist between the impala populations at the two sites and that the population with the highest BW should consist of larger framed individuals. If this is true it can be expected that impala at Mara should grow faster and reach mature BW at an older age than the impala at Messina. Numerous examples in livestock indicate that large framed cattle grow faster (Smith *et al*., 1976; Koch *et al*., 1979; Crouse *et al*., 1985) and reach maturity (O'Mary *et al*., 1979) at an older age than small framed cattle. Since impala from Mara were heavier than impala from Messina, but reached adult weight at an earlier age (RBW at Mara > RBW at Messina), this argument does not hold true. Therefore it can only be deducted that differences in post-weaning growth rates were due mainly to differences in the environment.

Table 2 Least square means (± s.e.) for relative body weight (RBW), relative cold carcass weight (RCCW) and relative dressing percentage (RDres%) of impala harvested from the Mara Research Station and the Messina Experimental Farm

Age classes	Sex	Site	n	RBW	P	RCCW	P	RDres%	P
Young (7-10 months)	Male	Mara	5	0.502 ± 0.017	NS	0.515 ± 0.028	NS	2.07 ± 0.06	NS
		Messina	23	0.507 ± 0.017		0.505 ± 0.020		2.22 ± 0.08	
	Female	Mara	7	0.569± 0.026	NS	0.593 ± 0.028	NS	2.34 ± 0.12	NS
		Messina	9	0.574 ± 0.027		0.567 ± 0.037		2.44 ± 0.08	
Sub-adult (19-34 months)	Male	Mara	24	0.759 ± 0.021	*	0.735 ± 0.021	NS	1.33 ± 0.05	***
		Messina	55	0.714 ± 0.011		0.721 ± 0.013		1.57 ± 0.02	
	Female	Mara	9	0.896 ± 0.024	*	0.871 ± 0.030	NS	1.37 ± 0.04	***
		Messina	32	0.811 ± 0.018		0.791 ± 0.032		1.79 ± 0.04	
Adult (>34 months)	Male	Mara	41					1.02 ± 0.02	***
		Messina	159					1.12 ± 0.01	
	Female	Mara	27					1.28 ± 0.03	***
		Messina	113					1.41 ± 0.02	

NS = Not significant, * = $P < 0.05$, *** = $P < 0.001$

The experimental design did not allow the determining of the exact environmental factors responsible for the differences in growth rates and weight parameters between Mara and Messina. However, one could speculate about the most unlikely and likely environmental factors that could have caused these differences. Internal parasites are an unlikely factor because both sites are located in arid regions with mean annual rainfalls of *ca*.450 mm and 350 mm for Mara and Messina, respectively.

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A most likely factor is the nutritional environment including forage availability and the nutritional value of the forage, especially macro-nutrients. Due to the short period during which animals were harvested at Mara, the effect of seasonal changes in forage composition and availability could not be resolved with this study. Energy expenditure to forage and to maintain body temperature (heat dissipation) undoubtedly also burdened impala at Messina more than at Mara.

It seems that Mara provides an environment conducive to a better expression of the full growth potential of impala. It is possible that other factors are responsible for suppressed expression of growth parameters. These factors include internal and external parasites, nutritional quality of the pastures as well as the seasonal variation in pasture quality. Although no data are yet available to support the theory that inbreeding might be partly responsible for the low growth rates and body weights of impala at Messina, it is highly likely to have contributed seeing that Messina game have been fenced in since the early 1980's.

Conclusions

Pre-weaning maternal effects were responsible for differences in the growth parameters of impala in the young age class (7 to 10 months of age). The main factors that caused differences in the post-weaning growth parameters between animals from Mara and Messina were environmental factors with the nutritional environment as the most likely one. The effects of forage quality and availability, and the seasonal variation thereof remain uncertain. Further research to clarify the effect of nutritional factors responsible for the differences in growth parameters between game from Mara and Messina as well as from other locations should be done. The level of inbreeding in isolated game populations should be established before meaningful deduction can be made concerning the effects of environmental factors on the growth and development of impala.

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