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Evaluation of Growth Trends in the Short-Eared Somali Goat Breed of Eastern Ethiopia

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Abstract: A study was conducted to assess the growth performance of the short-eared Somali goat breed in Eastern Ethiopia and quantify the effect of age and production site on these parameters. The quantitative traits recorded from linear body measurements of the adult female population (≥3PPI) averaged 21.86±2.89 kg, 56.42±3.53 cm, 65.39±3.68 cm, 60.95±2.82 cm, 7.78±1.18 and 13.89±1.04 cm for body weight, body length, chest girth, height at withers, chest width and pelvic width, respectively. The corresponding values for the male population were 24.17±4.75 kg, 57.36±4.53 cm, 66.78±5.97 cm, 63.6±3.83 cm, 7.8±1.33 cm and 13.66±1.52 cm, respectively. Effects of age (dentition group) on body weight and linear measurements was estimated using least square means to assess the growth trend in male and female animals of the population.

Key words: Short-eared Somali goats, body weight, linear traits, growth trend, population

INTRODUCTION

Ethiopia is home to the largest goat population in Africa, numbering 22.8 million heads (CSA, 2004). Goats are distributed in all agro-ecological zones of the country (Alemu, 2004) although the majority of the goat population is concentrated in the arid and semi-arid areas kept by pastoralists (Ayalew, 1992). Goats in Ethiopia are maintained under pastoralist/farmers management systems used as source of food (meat and milk), cash income, skin and manure (Zeleke, 2007). As subsistence goats are a low-cost and inflation-proof alternative of saving, their value provides asset (financing) and security (insurance) benefits at times of difficulty. Being small animal, compared to the big animals as cows, its value is not very high (Winrock International, 1992).

A study by Gebreyesus *et al*. (2013) has shown that sale of live-animals was the first ranked priority for keeping goats by Somali pastoralists in Eastern Ethiopia. Growth is the most important trait in small ruminant production affecting the contribution of the sector to the farm household through live animal sale and meat production (Deribe and Taye, 2013).

While the indigenous goat breeds of Ethiopia are generally perceived as low performing in terms of growth and body weight at marketing (Mekasha, 2007), no significant research focus has been given to evaluate their growth performance and available data on this regard is scanty. Part of this problem owes to the fact that indigenous goat breeds of the country are kept in extensive pastoral production systems making it difficult to undertake on farm productivity evaluation studies.

Apart from the logistics and infrastructural limitations, highly mobile nature of pastoral production systems, absence of formal record keeping and the fact that literacy rate is almost none in these areas are serious challenges for on-farm monitoring studies to evaluate growth performance of goats kept under extensive pastoral systems in the country.

Single-visit measurements are feasible alternatives in evaluating growth performance of goat populations kept in mobile pastoral production systems. Taking body weight and linear measurements on whole flock including kids and younger animals may be necessary to assess and compare growth trends (FAO, 2012). This research reports the growth trend of the short-eared Somali goat breed under the extensive pastoral production systems in Eastern Ethiopia.

MATERIALS AND METHODS

The study area: This study was carried out in the rural Peasant Associations (PAs) around Dire Dawa, located between 9°27'-9°49' North latitude and 41°38'- 42°19' East longitude in the Eastern part of Ethiopia (DDAC, 2002). The Eorth Eastern part of Dire Dawa is relatively sparsely populated lowland exhibiting pastoral and agro-pastoral system and the Southeastern part of the administration comprises of the escarpment with mixed farming system (DDAC, 2004). The study sites include Jeldesa, Goladeg and mudianeno Peasant Associations (PAs) found in the North-Eastern and North-Western parts of the Dire Dawa Administrative council. Goat and camel are the dominant livestock species in the study sites kept under Pastoral

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and Agro-Pastoral Production Systems. In the study sites, the short-eared Somali goat breed is preferred and predominantly kept by the Issa pastoralists.

Sampling framework and data collection procedures: Three PAs were selected for the study following purposive sampling approach considering goat production systems and location. The first PA, Jeldesa is located 40 km East of Dire Dawa and is characterized by Agro-Pastoral Production System while Mudianeno is 10 km East of Dire Dawa and is characterized by a transhumant pastoralist production system. The third PA, Goladeg is located 42 km West of Dire Dawa and was characterized with a predominantly nomadic system.

Sample goats for measurements were taken from randomly selected whole flocks including kids within villages at each PA until the target total number of animals was achieved (Table 1). The age of animals was estimated from dentition to support the age information provided by owners. Summarized details of the sample size are shown in Table 1. Quantitative measurements of linear traits (cm) and body weight (kg) were taken on sample goats using standard plastic tapes and a 100 kg portable balance, respectively. Linear measurements included body length, chest girth, height at wither, chest width and pelvic width.

Data analysis: The General Linear Model (GLM) procedures of SAS were employed on metric data to dentition (PPI) and study site (PA) class effects. The effects of class were expressed as Least Square Means (LSM±SE). Means were separated using Tukey-Karamers.

Table 1: Summary of total number of samples by PA

		Number of animals sampled for measurement					
		Female					Male
PA	No. of villages	0PPI	1PPI	2PPI	3PPI	4PPI	0-4PPI
Jeldesa	3	18	24	45	118	42	65
Mudianeno	2	18	16	50	106	51	69
Goladeg	2	31	25	31	63	83	40
Total	7	67	65	126	287	176	174

PPI = Pairs of Permanent Incisors; PA = Peasant Association

Analysis was done for both sexes, independently, in which PA and dentition were fitted as fixed factors. Measurements recorded for 3PPI and 4PPI age groups in the male sample was pooled in running the GLM procedure as a preliminary analysis undertake found no statistically significant difference between the age groups for all the traits considered and the number of male animals at 3PPI and 4PPI was very low. The model used for body weight and linear measurements:

$$Y_{ij} = \mu + A_i + S_j + e_{ij}$$

Where:

Y_{ij} = The observation of body measurements and body weight
μ = Overall mean
A_i = The effect of ith age group (i = 1, 2, 3, 4PPI)
S_j = The effect of jth site or PA (j = Mudianeno, Jeldesa and Goladeg)
e_{ij} = Random residual error

RESULTS AND DISCUSSION

Mean values for live-body weight and linear traits in the adult goats: The mean body weight computed for the adult male population was 24.17 kg with standard deviation of 4.75 while the same for the female counterparts was 21.86 kg with standard deviation (Table 2). Despite the longer drought in the study areas during the time of data collection for this study, these findings are still higher than the Mean Population Body Weight (MPW) of 18 kg suggested for goats in tropical Africa.

Effect of age on live body weight and linear measurements: The body weight and linear measurements for female goats at various ages are presented in Table 3. In the female sample population, age was found to strongly influence ($p<0.01$) all measurements. For body weight, body length, chest girth, pelvic width and withers height, all the female age groups had significantly higher ($p<0.01$) values over the preceding age groups. There was wide variability as the

Table 2: Mean values for body weight and linear traits in adult male and female animals (≥3PPI)

		Parameters (Mean±SD)					
PA	N	BW	BL	CG	WH	CW	PW
Female							
Jeldesa	160	21.41±2.63	58.57±3.70	64.3±3.570	61.75±3.20	7.50±0.94	14.28±1.06
Mudi	157	21.18±2.62	55.59±3.18	65.65±3.36	60.35±2.24	7.43±0.93	13.50±1.09
Goladeg	146	23.06±3.08	57.14±3.54	66.30±3.65	60.70±2.73	8.47±1.38	13.90±0.78
Overall mean	463	21.86±2.89	56.42±3.53	65.39±3.68	60.95±2.82	7.78±1.18	13.89±1.04
Male							
Jeldesa	24	23.58±5.06	57.38±4.85	65.39±6.50	64.02±3.96	7.70±1.02	13.60±1.68
Mudi	12	24.91±4.90	57.41±4.79	69.33±4.96	62.83±3.63	7.83±1.95	13.50±1.39
Goladeg	12	25.50±1.47	57.00±1.41	67.50±2.67	63.37±4.30	8.25±0.95	14.50±0.70
Overall mean	48	24.17±4.75	57.36±4.53	66.78±5.97	63.6±3.830	7.8±1.330	13.66±1.52

PA = Peasant Association; BW = Body Weight (kg), BL = Body Length (cm); CG = Chest Girth (cm); CW = Chest Width (cm); WH = Wither Weight (cm); PW = Pelvic Width (cm)

Table 3: Least Square Means and Standard Error (LSM±SE) for main effects of dentition (PPI) and site (PA) on the body weight and linear measurements in female goats

Effects and level	N	BW	BL	CG	WH	CW	PW	BC
Overall	530	17.58±0.11	51.39±0.16	59.91±0.15	57.04±0.12	7.43±0.04	12.4±0.04	2.76±0.03
CV	-	13.4	6.8	5.77	4.82	13.92	8.63	25.49
R^2	-	0.67	0.59	0.63	0.60	0.21	0.58	0.07
Dentition	-	**	**	**	**	**	**	**
0PPI	52	11.48±0.32^a	44.4±0.45^a	51.83±0.44^a	50.97±0.35^a	6.8±0.13^a	10.2±0.14^a	2.87±0.09^{ab}
1PPI	46	13.43±0.32^b	46.67±0.45^b	54.6±0.44^b	53.29±0.35^b	7.13±0.13^a	11.07±0.14^b	3±0.09^a
2PPI	96	18.77±0.23^c	52.48±0.32^c	61.68±0.32^c	58.72±0.25^c	7.6±0.09^b	12.85±0.1^c	2.77±0.06^{ab}
3PPI	213	21.14±0.16^d	55.52±0.21^d	64.35±0.21^d	60.36±0.17^d	7.74±0.06^b	13.69±0.07^d	2.65±0.04^{bc}
4PPI	123	23.07±0.2^e	57.9±0.28^e	67.12±0.27^e	61.85±0.21^e	7.9±0.08^b	14.21±0.09^e	2.50±0.05^c
PA	-	**	**	*	**	**	**	**
Jeldesa	189	17.56±0.18^a	52.04±0.25^a	59.56±0.25^a	58.21±0.19^a	7.19±0.07^a	12.96±0.08^a	2.61±0.04^a
Mudi	148	16.72±0.18^b	50.24±0.26^b	59.77±0.25^{ab}	56.04±0.2^b	7.03±0.07^a	11.91±0.08^b	2.76±0.04^b
Goladeg	193	18.46±0.2^c	51.93±0.25^a	60.43±0.24^b	56.87±0.19^c	8.09±0.07^b	12.34±0.08^c	2.9± 0.04^b

$^{a-e}$Means on the same column with different superscripts, within the specified class variable, are significantly different ($p<0.05$); NS = Non Significant; *$p<0.05$; **$p<0.01$; BW = Body Weight; BL = Body Length; CG = Chest Girth; CW = Chest Width; WH = Wither Height; PW = Pelvic Width; 0PPI = 0 Pair of Permanent Incisors, 1PPI = 1 Pair of permanent Incisors; 2PPI = 2 Pairs of Permanent Incisors; 3PPI = 3 Pairs of Permanent Incisors; 4PPI = 4 Pairs of Permanent Incisors

Table 4: Least Square Means and Standard Error (LSM±SE) for main effects of dentition (PPI) and site (PA) on the body weight and linear measurements in male goats

Effects and level	N	BW	BL	CG	WH	CW	PW	BC
Overall	114	19.36±0.33	52.67±0.42	61.41±0.47	58.88±0.4	7.6±0.1	12.29±0.14	3.06±0.04
CV	-	19.15	8.25	7.71	6.84	14.53	12.05	15.9
R^2	-	0.69	0.62	0.62	0.61	0.23	0.54	0.08
Dentition	-	**	**	**	**	**	**	NS
0PPI	40	12.44±0.46^a	44.8±0.59^a	53.19±0.64^a	52.70±0.55^a	6.87±0.15^a	10.19±0.19^a	2.97±0.06^a
1PPI	41	14.56±0.44^b	48.61±0.57^b	55.13±0.62^a	53.91±0.53^a	7.09±0.14^a	10.73±0.19^a	2.99±0.07^a
2PPI	18	19.77±0.65^c	54±0.83^c	63.02±0.91^b	60.46±0.79^b	7.81±0.21^b	12.34±0.28^b	2.9±0.09^a
>3PPI	15	24.75±0.53^d	57.94±0.69^d	67.75±0.75^c	63.76±0.64^c	8.03±0.17^b	13.77±0.23^c	3.2±0.08^a
PA	-	**	**	**	**	**	**	NS
Jeldesa	36	17.08±0.41^a	50.9±0.52^a	57.93±0.58^a	58.02±0.49^a	7.11±0.13^a	11.75±0.17^{ab}	3.08±0.06^a
Mudi	48	16.99±0.39^a	49.49±0.53^a	59.54±0.58^a	56.12±0.49^b	7.11±0.13^a	11.23±0.17^a	2.9±0.06^a
Goladeg	30	19.58±0.48^b	53.62±0.69^b	61.84±0.76^b	58.98±0.65^a	8.13±0.17^b	12.29± 0.23^b	3.08±0.08^a

$^{a-e}$Means on the same column with different superscripts, within the specified class variable, are significantly different ($p<0.05$); NS = Non Significant; *$p<0.05$; **$p<0.01$; BW = Body Weight, BL = Body Length; CG = Chest Girth; CW = Chest Width; WH = Wither Height; PW = Pelvic Width; 0PPI = 0 Pair of Permanent Incisors, 1PPI = 1 Pair of Permanent Incisors; 2PPI = 2 Pairs of Permanent Incisors; >3PPI = 3 or more Pairs of Permanent Incisors

age of the animals increased for these body measurements. This implies that these variables might best explain the growth pattern of the animals. On the contrary, variables such as chest width and body condition score were less influenced by age and showed less variation as age advances.

The maximum variation in values for all measurements except body condition score was observed between animals of dentition groups one and two. There was a sharp decline in difference between values for body weight, body length, chest girth and wither height post dentition group two. Meanwhile, the least variation in values for these parameters was observed between the dentition groups three and four. This is expectable since animals under normal conditions, grow fast when younger but grow slowly when they reach maturity (Mekasha, 2007). Nevertheless, it also suggests that the age between the appearance of the first and second pairs of permanent incisor may be the physiological age gap in which the animal shows the fastest growth rate. Despite exhibiting the lowest variations in values for most measurements, the differences between the dentition groups three and four in values for these measurements were still highly significant ($p<0.001$). Moreover, all the measurements except body condition score had their maximum values at the oldest age group (4PPI). This suggests that although the fastest growth rates were observed at the early to intermediary physiological age, the animals may not attain their mature body weight and other parameters before reaching the old age group (4PPI). Earlier findings by Mekasha (2007) has shown that large sized indigenous bucks reach maturity at later age as compared to early maturing small sized bucks. Yet, the generally lower values in body weight and other linear measurements in the current study do not suggest that the population could be described as large-sized despite showing a late-maturing growth pattern. This might be explained by other environmental effects such as season and nutrition. This may coincide with the fact that the study was conducted amid a drought condition that persisted in the area since 2008. However, the observed late-maturing growth pattern may by itself suggest that the breed has a potential to achieve heavier body weight under improved environmental conditions. Likewise, in males dentition significantly affected ($p<0.01$) all the measurements except ($p>0.05$) body condition score (Table 4). Variation in

values for all parameters between animals in dentition groups three and four was not significant ($p>0.05$). Hence, the data for these dentition groups were pooled together for estimation of least square means for the class variables. Similar to the case in the females, largest significant ($p<0.01$) variation in body weight and other measurements was observed in male animals between dentition group one and two. For the values in chest width, the variation between dentition groups one and two represented the only significant ($p<0.001$) between-age group difference. The parameters body weight, body length, chest girth, withers height and pelvic width also had their lowest differences in values computed between animals in dentition group two and those in the pooled group for three and above PPI. This may suggest that the male animals, similar to their female counter parts, tend to show the fastest growth rate during the early age. Nevertheless, the maximum values for all measurements were computed for animals at the older age groups (4PPI), despite insignificant ($p>0.05$) difference over the preceding age group (3PPI). This finding might suggest that the male animals as their female counter parts may not reach at maturity early. As opposed to the cases of the females, this finding might have important implication with regard to management decisions pertaining male animals as the bulk of them are kept for live-sale. The insignificant difference in most parameters post the third dentition group may suggest that keeping the males post this age may not be advantageous in terms of weight at sale, unless kept for breeding. Optimum body weight and size at sale can be achieved during the third age group. Hence, disposing the males at this age allows additional advantage of achieving these with reduced pressure on the grazing land as compared to the insignificant weight gains in the old age.

CONCLUSION

The short-eared Somali goat breed is kept under extensive Pastoral Production Systems in Eastern Ethiopia. Despite the recurrent droughts affecting the production area and the very low input characterizing the production system, the study has shown that the short-eared Somali population in Eastern Ethiopia has a fairly good performance in terms of adult body weight. Despite the fact that fastest growth rates were observed at the early to intermediary physiological age, the animals may not attain their mature body weight and other parameters before reaching the old age group (4PPI) with an indication of a late maturing growth pattern.

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