jotaf **Journal of Tekirdag Agricultural Faculty**
Tekirdağ Ziraat Fakültesi Dergisi

Ocak/January 2024, 21(1)
Başvuru/Received: 05/04/23
Kabul/Accepted: 11/07/23
DOI: 10.33462/jotaf.1277523

http://dergipark.gov.tr/jotaf
http://jotaf.nku.edu.tr/

ARAŞTIRMA MAKALESİ **RESEARCH ARTICLE**

Defining of Some Morphological Characteristics in order to Determine the Infrastructure of Conservation Strategies of Indigenous Cattle for Designing Sustainable Methods and Conservation of Biodiversity: Eastern Anatolian Red Example Reared Under Ex-Situ Conditions in Türkiye

Sürdürülebilir Yöntemlerin Tasarlanması ve Biyoçeşitliliğin Muhafazasına Yönelik Yerli Sığırları Koruma Stratejilerinin Alt Yapısını Belirlemek için Bazı Morfolojik Özelliklerin Tanımlanması: Türkiye'de Ex-Situ Koşullarda Yetiştirilen Doğu Anadolu Kırmızısı Örneği

Sadrettin YÜKSEL[1]*, Alpay KARAÇUHALILAR[2]

Abstract

This study was designed to protect indigenous animal breeds as an infrastructure for the continuation of biodiversity and to be a link in the production chain. For this purpose, the interaction of the information on Eastern Anatolian Red (EAR) breed, which were evaluated or protected according to different methods, and some morphological characters of animals reared under ex-situ conditions, with the sources of variation were evaluated. It were used materials preserved according to different methods and 207 head calves obtained during four years in the study. The materials that consisted of 350 head ex-situ, 200 head in-situ, 50 piece in-vitro was conserved in original environment. The weights and measurements of calves were recorded at birth and weaning. Difference of CV was the highest that was seen between males and females in 2022 (%9.24, %19.23 respectively) in birth. It was observed a certain level of difference for CV for BL, WH, CD, CW, CG, RH and FWG both between sexes and between years in weaning, but these differences were not as large as at birth. BW, WH, CW, CG, RH and FWG differed between sexes in birth period ($p< 0.05$). In the same period, all body measurements were different between years ($p< 0.01$). In weaning period, difference of CV for WW was the highest that was seen by sex in 2019 (%9.64, %15.47 female, male, respectively). In the same period, it was close CV values of body measurements determined by both sexes and years. There was an interaction between sexes and WW, CW, FWG ($p< 0.05$), years and all body measurements ($p< 0.01$) in the weaning period. The increase in studies on EAR breed could result in a modulation of sustainable of animal biodiversity potentially impacting livestock control and efficiency.

Keywords: Eastern Anatolian Red, Ex-situ rearing, Conservation of biodiversity, Calf, Morphological Characteristic

[1]***Sorumlu Yazar/Corresponding Author:** Sadrettin Yüksel, Atatürk Üniv. Ziraat Fak. Zootekni Böl., Erzurum and Türkiye. E-mail: syuksel@atauni.edu.tr OrcID: 0000-0003-4478-8605

[2]Alpay Karaçuhalılar, Doğu Anadolu Tarımsal Araştırma. Enstitüsü, Erzurum, Türkiye. E-mail: alpay.karacuhalilar@tarimorman.gov.tr OrcID: 0000-0003-1512-7728

Atıf: Yüksel, S., Karaçuhalılar, A. (2024). Sürdürülebilir yöntemlerin tasarlanması ve biyoçeşitliliğin muhafazasına yönelik yerli sığırları koruma stratejilerinin alt yapısını belirlemek için bazı morfolojik özelliklerin tanımlanması: Türkiye'de Ex-Situ Koşullarda yetiştirilen Doğu Anadolu Kırmızısı örneği. *Tekirdağ Ziraat Fakültesi Dergisi, 21*(1): 233-245.

Citation: Yüksel, S., Karaçuhalılar, A. (2024). Defining of some morphological characteristics in order to determine the infrastructure of conservation strategies of indigenous cattle for designing sustainable methods and conservation of biodiversity: Eastern Anatolian Red example reared under ex-situ conditions in Türkiye. *Journal of Tekirdag Agricultural Faculty*, 21(1): 233-245.

*Bu çalışma Tarım ve Orman Bakanlığı TAGEM Yerli Gen Kaynaklarının korunması projesi kapsamında hazırlanmıştır.

Öz

Bu çalışma, biyoçeşitliliğin devamı için, bir altyapı olarak yerli hayvan ırklarının korunması ve üretim zincirinin bir halkası olması amacıyla tasarlanmıştır. Bu maksatla farklı yöntemlere göre koruma altına alınmış veya değerlendirilmiş Doğu Anadolu Kırmızısı (DAK) ırkına ait bilgilerin ve ex-situ koşullarda yetiştirilen hayvanların bazı morfolojik karakterlerinin, varyasyon kaynakları ile etkileşimi ele alınmıştır. Çalışmada, farklı yöntemlerle korunan materyallerin durumu ve dört yıl boyunca elde edilen 213 baş buzağıya ait veriler kullanılmıştır. Koruma altındaki materyaller, 350 baş ex-situ, 200 baş in-situ, 50 adet in-vitrodan oluşmaktadır. Buzağıların doğum ve sütten kesim dönemlerine ait ağırlıkları ve vücut ölçüleri kayıt altına alınmıştır. Dişi ve erkekler arasında en yüksek varyasyon katsayısı (VK) farkı 2022 yılında doğum ağırlıklarında görülmüştür (sırasıyla %9.24, %19.23). Sütten kesim döneminde vücut uzunluğu (VU), cidago yüksekliği (CY), göğüs derinliği (GD), göğüs genişliği (GG), göğüs çevresi (GÇ), sağrı yüksekliği (SY) ve ön incik çevresi (ÖİÇ) için VK değerleri hem cinsiyetler arasında hem de yıllar arasında belirli bir düzeyde farklılık göstermiş, ancak bu farklar doğumdaki değerler kadar büyük olmamıştır. Doğum döneminde VU, CY, GG, GÇ, SY ve ÖİÇ ortalamaları cinsiyetler arasında farklılık göstermiştir ($p< 0.05$). Aynı dönemde yıllar arasındaki tüm vücut ölçüsü değerlerine ait farklılıklar önemli bulunmuştur ($p< 0.01$). Sütten kesim döneminde cinsiyetler arasında görülen en yüksek VK farkı 2019 yılında CY değerinde görülmüştür (dişi, erkek için sırasıyla %9.64, %15.47). Aynı dönemde hem cinsiyet, hem de yıllara göre belirlenen vücut ölçülerinin VK değerleri birbirine yakın bulunmuştur. Sütten kesim döneminde cinsiyet ile CY, GD, ÖNÇ ($p< 0.05$), yıl ile tüm vücut ölçüleri ($p< 0.01$) arasında anlamlı bir etkileşim görülmüştür. Nihayi olarak DAK ırkı üzerine yapılan araştırmalardaki artış, sürdürülebilir bir biyoçeşitlilik modülasyonuyla sonuçlanıp, potansiyel olarak çiftlik hayvanlarının kontrolünü ve verimliliğini etkileyebileceği sonucuna varılmıştır.

Anahtar Kelimeler: Doğu Anadolu Kırmızısı, Ex-situ yetiştirme, Biyoçeşitliliğin korunması, Buzağı, Morfolojik özellik

1. Introduction

The livestock, particularly cattle and sheep, have played an important part in the achieving of food, scientific study, and employment overall world. Because humankind as a living creature have probably an the longest history of agriculture culture on the planet. These definitions can also bring up the morphological type scoring process (Soysal et al., 2016) in these animals in line with the estimation of climatic factors with some methods (Halimi et al., 2023). Today, many things in terms of animal husbandry may have changed or developed, but still, for the continuation of human life, you need to a detailed description of indigenous animals. Eastern Anatolian Red is one indigenous cattle breeds of Türkiye. The origin of this breed goes back to about 3500 years ago (Ozdemir and Dogru, 2009). Previous breeders raised these animals both food production and draft animal in agricultural activities (Üresin, 1936). However, since the beginning of the 1970s, farmers begun to used by choosing certain exotic breeds (Yüksel, 2019a). Desired characters included products such as more meat and milk. Thus, this breed have began to decline in numbers. Sustainable conservation of these cattle are very important due to their rooted past, which may have promoted the realization of traditional production and modern breeding studies. Nonetheless, determination of morphological characterization the breed is important for the conservation and biodiversity of cattle breeds (Alderson, 1992). By studying the phenotype of the breed, it is possible to improve diversity and reproductivity for profitable livestock and functionality (Eding and Laval, 2002). According to visual methods provide a painless mechanism to evaluate the EAR breed morphologically but is very laborious, and precision requires a high sampling rate (Garcia-Lamazares, 2008).

It were used materials preserved according to different methods and EAR calves obtained during four years in the study. The materials that consisted of 350 head ex-situ, 200 head in-situ, 50 piece in-vitro was conserved in original environment. Previous researchers described the morphology and some phenotypes of the EAR cattle breed. However, this study focused on measurements and evaluations in ex-situ conditions in terms of creating infrastructure for new research and strategies in cattle breed, bringing these strategies into production and protecting the breed.

2. Materials and Methods

In this study, morphological characteristics was conducted from January 2019 to December 2022 on purebred EAR cattle herd consisting 213 head in Eastern Anatolian Agricultural Research Institute. The weather of the area is consisted of by a continental climate and cold season. The region is classified as area having a little amount of rainfall throughout the summer located 1950 m above the sea level, 39°55′15.49″N, 41°17′12.90 E. The information about the practices consists of the projects carried out by the Ministry of Agriculture and Forestry, to which the institute is affiliated. Total 213 (106 females and 107 males) purebred EAR calves were used for the body measurements and weights. All calves received colostrum 2 liter approximate, within first 1-3 h of birth. Then, their mothers were suckled to them until weaning. Starter and grass hay were available *ad-libitum* starting on 5-6 day. It was used a precision bascule (10 g sensibility) for body weights and a measuring stick also for body measurements. These phenotypic characteristics were recorded for each animal individually. Measures are as following; body length (BL) the horizontal distance from the point of shoulder to pin bone, wither height (WH) distance (vertical) from the bottom of the front foot to the highest point over wither, chest depth (CD) distance from the shoulder to just behind the front legs, chest width (CW) distance between two scapula bones, heart girth (HG) by placing the measuring tape around the animal at the point of smallest circumference just behind the forelegs, rump height (RH) distance from the apex of the hipbone to the ground perpendicular to the ground and front wrist girth (FWG) circumference of the fore ankle.

In the analysis of the data were used the descriptive analysis method and was benefited from the SPSS package program (SPSS, 2004). On the other hand, were also statistically analyzed by the least squares techniques by using SPSS statistics software program (SPSS, 2004). A general linear model was carried out for fixed effect of sex and years the main sources of variation for studied traits in statistical analysis. The mathematical differences detected were grouped according to the Duncan multiple comparison test (Duncan, 1955).

3. Results

3.1. Evaluation of conservation practices

It should have stated that scientists and readers have been arguing for always that calves "needed a space to feed around with sufficient of feeds for profitability, a rearing programme for these animals and a variety of environmental regulations to keep them sustainable conserved". Although the studies we have carried out in this context have kept the EAR breed on the agenda to a certain extent, there is still more research to be done. Activities for the breeding and protection program made for the breed are given in *Table 1*.

Table 1. Local level of the Eastern Anatolian Red breed within the project

Rearing style	Conservation style	Location	*Condition	Frequency (number)
Semi-intensive	Ex situ-in vivo	EAAR	-	> 350
Extensive	In situ- in vivo	Erzurum/ Olur/Kekikli	+	> 100
Extensive	In situ- in vivo	Artvin/ Ardanuç/Güleş	+	> 100
Intensive	In vitro-in vivo	MAF/GDARP/ICLRT	-	≥ 50

EAAR: Eastern Anatolian Agricultural Research, Semi-intensive: a system between extensive and intensive, MAF: Ministry of Agriculture and Forestry, GDARP: General Directorate of Agricultural Research and Policies, ICLRT: International Center for Livestock Research and Training, *: It is supported in cash by the Ministry of Agriculture and Forestry.

Most of the EAR cattle breed are found in certain number in the hubbly and steep areas. The dominant issues to address therefore relate to reducing under-research, enhancing production with local EAR breed, combating uncontrolled crossbreeding, and achieving rates and research of biodiversity growth that would contribute to animal production development. Thus, it is important to make the EAR breed a link in the animal production chain. The studies carried out for this purpose are given in *Table 2*.

Table 2. Usage strategy of the Eastern Anatolian Red breed within the projects

Location	Issue	Reference
Erzurum/TÜRKİYE	Calves feeding and overall herd performance	Yüksel et al., 2021
Erzurum/TÜRKİYE	Relationship among housing, feeding, age and fattening performances, comfort, slaughterhouse characteristics	Yüksel, 2019b
Erzurum/TÜRKİYE	Relationship between rearing style and social awareness	Yüksel et al., 2019
Erzurum/TÜRKİYE	Relationship among housing condition, feeding style, age and meat quality	Yüksel et al., 2019
Erzurum/TÜRKİYE	Relationship between age and meat quality	Kopuzlu et al., 2018
Erzurum/TÜRKİYE	Relationship between finishing system and meat quality	Yüksel et al., 2012
Erzurum/TÜRKİYE	Reletionship between duration of finishing period and meat quality	Özlütürk et al., 2008
Erzurum/TÜRKİYE	Reletionship between finishing period and meat quality	Ünlü et al., 2008
Erzurum/TÜRKİYE	Fattening performance	Özlütürk et al., 2006
Erzurum/TÜRKİYE	Controlled crossbreeding, genotype environment interaction, meat and carcass quality	Özlütürk et al., 2004

3.2. Evaluation of some morphological characterization

The data obtained by descriptive analysis and the least squares techniques for birth and weaning periods are presented in *Table 3*, *Table 4*, *Table 5* and *Table 6*, respectively. The CV for the birth weight varied from 9.62% to 19.23% in female, from 8.49% to 9.24% in male for years and variation was hight in females. Birth weight for males and 2019 year were significantly (P=0.010) greater than females and another years. The highest CV for BL

in the males and females were in 2020 and 2022 years, respectively, with a highly significant (P=0.000) mean differences between the sexes. And, WH for this parameter was significantly (P=0.000) larger in males than females. Furthermore, the highest CV ratios of CD was in 2021 (7.93%) and 2022 (5.79%) years for females and males respectively, and the least squares means differences were no significant for sex and were highly significant (P=0.000) among years. Over years, CV belonging to CW differed significantly (P=0.000) with 5.65, 5.23, 8.06, 8.94 and 5.56, 4.96, 8.86, 7.94 for females and males, respectively.

The CV for the CG varied from 4.25% to 6.53% in female, from 3.36% to 4.95% in male for years and differences for the least square means was significantly (P=0.015, P=0.000) in terms of sex and years. Significant (P=0.033, P=0.000) difference was found in males and females for third the least square means. Similarly, the least square mean differences for FWG was found significantly (P=0.000) both males and females.

CV value of sex and years were calculated in weaning period. Sex had variation a different ratio on CV values of WW (15.47), BL (5.63), WH (4.65), CD (6.27), CW (6.90), CG (7.31) and RH (4.85) values, with male values having higher than that of female. Females had higher FWG' CV value. In 2022 year, CV ratio of WW, BL, WH was higher both male and female (18.87, 11.99, 4.44 and 17.76, 9.56, 3.98 respectively), than other year' values. The highest CV values were found in 2019 for CD (in both sex, in male and female, 6.27 and 4.96, respectively), in males (6.90) in 2019, in females (5.49) in 2020 for CW, in males (7.31) in 2019 and in females (7.76) in 2022 for CG. Analysis of variance showed effect of sex on some parameters while no effects the similar were found on some's. Sex had a significant effect on WW ($p = 0.020$), CW ($p = 0017$) and FWG ($p = 0.000$) values, with male values having higher than that of female. But, no effects the similar were found on BL, WH, CD, CG and RH ($p > 0.05$). On the other hand, there was effect of years on all parameters considered in the study (P=0.000). 2019 year value had the highest levels of WW in the current dataset (58.81) with 2020 and 2022 (47.16, 45.48 respectively), the lowest. BL was similar for both 2021 and 2022 years effects (67.63, 67.94 respectively), with 2019 having the highest value (73.18). WH and RH values tended to be higher in 2019 year (79.85, 85.64 respectively) than in other years; however, 2021 year had an similar trend in terms of CY. 2021 year values had the highest levels of CD, CW and CG in the current assessments (34.85, 24.39 and 101.61 respectively) with 2022 year' CG value, the lowest (90.47). In terms of FWG values, 2020 and 2021 have the lowest values (10.23 and 10.29 respectively), while 2019 is the highest (11.18)

4. Discussion

Although the Erzurum and surrounding provinces are gifted with a very high potential for livestock resources, the EAR breed's contribution to the region because of some reasons is much lower than in an ideal world. Whereas, EAR breed production has to potential a considerable contribution to the economy of the region (Yüksel et al., 2019) and plays a nonignorable role in providing commodities like meat and meat products, live animals, hides and skins, and leather products. Although there are opportunities and desire to rearing with this breed of rearers (Yüksel, 2019a), there is still the paradox of the ever-increasing enters of some breeds and animal products from outside the region, even if state of enterprise of the region are tending to inconvenience. Bujko et al. (2019) reported higher CV values than our findings for birth weights of different herds. CV values of defined BW in both male and female EAR calves for 2019 and 2020 years were lower than the values reported for the Gascon breed by Bures et al. (2008). However, the same researchers reported higher CV values than 2021 and 2022 years of male calves of the present study. Our findings for CV values in birth period were partially similar to some researchers reports (Putra et al., 2014). CV values defined for WH in both sex in the study were lower than the values for Gascon breed reported by Bures et al. (2008).

Some researchs have shown that when sex for diverse breeds are compared at the same period variation will be found in birth weight. The similarities found in the effect of sex on birth weight are in line with variations found by Nahar et al. (2016), Ulutaş et al. (1996) for the Red Chittagong and EAR breeds, respectively, ($p<0.05$). Higher BW than from different years and sexs of this study were reported for Braford (Vaz et al., 2020), male Sumbo Ongale (Said et al., 2016), Brown Swiss X EAR F_1 (Koçyiğit et al., 2015), Gascon calves (Bures et al., 2008). However, it was reported lower BW values in terms of both sources of variation for Yerli Kara (Sakar and Zülkadir, 2022), Red Chittagong (Nahar et al., 2016), female Sumbo Ongale (Said et al., 2016), Aceh (Putra et al., 2014), Assam (Kayastha et al., 2008), EAR (Yıldız et al., 2008), and EAR calves (Ulutaş et al., 2001).

Table 3. Descriptive Analysis values for the birth period of Eastern Anatolian Red calves reared under ex-situ conditions.

MC	S	2019 n=28 F, 30 M			2020 n=29 F, 27 M			2021 n=33 F, 27 M			2022 n=16 F, 17 M			Overall n=106 F, 107 M		
		(X̄)	SD	CV (%)	(X̄)	SD	CV (%)	(X̄)	SD	CV (%)	(X̄)	SD	CV (%)	(X̄)	SD	CV (%)
BW (kg)	F	26.23	2.52	9.62	18.81	2.26	12.02	20.51	3.51	17.15	19.13	3.68	19.23	22.01	4.17	18.94
	M	27.70	2.35	8.49	19.87	2.29	11.53	21.29	2.48	11.69	21.08	2.08	9.24			
BL (cm)	F	57.67	3.93	6.82	48.44	2.73	5.64	53.18	3.72	7.00	50.12	4.33	8.65	53.11	5.04	9.48
	M	58.63	3.43	5.87	48.88	3.44	7.05	53.96	3.48	6.45	51.82	3.02	5.84			
WH (cm)	F	68.96	2.57	3.73	62.51	1.88	3.01	63.72	1.94	3.05	62.00	2.82	4.56	64.93	3.79	5.83
	M	70.13	2.82	4.03	62.74	2.14	3.41	64.37	2.51	3.91	62.76	2.33	3.72			
CD (cm)	F	27.85	1.40	5.05	25.51	1.32	5.41	26.57	2.10	7.93	23.68	1.01	4.28	26.02	2.13	8.18
	M	28.06	1.43	5.12	24.55	1.01	4.12	26.74	1.53	5.74	24.52	1.41	5.79			
CW (cm)	F	17.60	0.99	5.65	16.58	0.86	5.23	16.36	1.31	8.06	16.06	1.43	8.94	16.90	1.28	7.57
	M	17.90	0.99	5.56	16.81	0.83	4.96	16.74	1.48	8.86	16.94	1.34	7.94			
HG (cm)	F	71.71	3.30	4.61	64.82	2.75	4.25	62.63	3.19	5.11	64.81	4.23	6.53	66.62	4.73	7.09
	M	72.40	3.50	4.85	65.11	2.18	3.36	64.51	3.26	5.06	66.58	3.29	4.95			
RH (cm)	F	74.00	2.47	3.35	66.62	2.07	3.12	68.03	2.37	3.50	66.56	3.09	4.65	69.44	3.97	5.71
	M	74.43	2.84	3.83	67.11	2.24	3.34	69.25	2.62	3.79	67.47	2.76	4.10			
WFG (cm)	F	10.53	0.50	4.82	9.01	0.50	5.64	9.00	0.71	7.98	9.43	0.54	5.76	9.69	0.87	8.97
	M	10.85	0.49	4.55	9.40	0.41	4.43	9.44	0.60	6.46	9.88	0.62	6.33			

Birth weight (BW), body length (BL), wither height (WH), chest depth (CD), chest width (CW), heart girth (HG), rump height (RH), front wrist girth (FWG), (X̄): mean, SD: Standard deviation, CV: Coefficient of variation, S: Sex, F: Female, M: Male, MC: Morphological characters

Table 4. Variance analysis and multiple comparison test results of Eastern Anatolian Red calves reared under ex-situ conditions in birth period.

MC	Overall	Sex ($\bar{X}\pm S_{\bar{x}}$)			Birth year ($\bar{X}\pm S_{\bar{x}}$)				
		Female	Male	p-value	2019	2020	2021	2022	p-value
BW (kg)	21.83±0.19	21.22±0.26	22.46±0.27	0.001	26.97^{a}±0.35	19.34^{c}±0.35	20.93^{b}±0.34	20.12^{bc}±0.46	0.000
BL (cm)	52.84±0.25	52.40±0.34	53.29±0.35	0.071	58.11^{a}±0.46	48.67^{d}±0.46	53.57^{b}±0.45	50.98^{c}±0.60	0.000
WH (cm)	64.64±0.17	64.30±0.23	65.00±0.23	0.035	69.55^{a}±0.31	62.63^{c}±0.31	64.05^{b}±030	62.38^{c}±0.41	0.000
CD (cm)	25.81±0.10	25.69±0.14	25.94±0.14	0.225	27.96^{a}±0.19	24.54^{c}±0.19	26.66^{b}±0.19	24.11^{c}±0.25	0.000
CW (cm)	16.87±0.08	16.68±0.11	17.07±0.11	0.015	17.75^{a}±0.15	16.70^{b}±0.15	16.55^{c}±0.14	16.50^{c}±0.20	0.000
HG (cm)	66.56±0.23	66.02±0.31	67.11±0.32	0.015	72.05^{a}±0.42	64.98^{b}±0.42	63.53^{c}±0.41	65.71^{b}±055	0.000
RH (cm)	69.17±0.18	68.0±0.25	69.55±0.25	0.033	74.21^{a}±0.33	66.87^{c}±0.33	68.62^{b}±0.32	67.01^{c}±0.43	0.000
FWG (cm)	9.69±0.04	9.49±0.05	9.89±0.05	0.000	10.69^{a}±0.07	9.21^{c}±0.07	9.22^{c}±0.07	9.66^{b}±0.09	0.000

Birth weight (BW), body length (BL), wither height (WH), chest depth (CD), chest width (CW), heart girth (HG), rump height (RH), front wrist girth (FWG), $\bar{X}$: mean, $S_{\bar{x}}$: Standart error, MC: Morphological character, a-d: values with different letters in the same column are statistically different

Table 5. Descriptive Analysis values for the weaning period of Eastern Anatolian Red calves reared under ex-situ conditions.

MC	S	2019 n=27 F, 30 M			2020 n=29 F, 27 M			2021 n=33 F, 27 M			2022 n=16 F, 17 M			Overall n=105 F, 101 M		
		(X̄)	SD	CV (%)	(X̄)	SD	CV (%)	(X̄)	SD	CV (%)	(X̄)	SD	CV (%)	(X̄)	SD	CV (%)
WW (kg)	F	59.03	5.69	9.64	44.90	6.30	14.02	50.13	6.85	13.66	45.98	8.16	17.76	51.56	9.02	17.49
	M	58.59	9.06	15.47	49.42	7.03	14.23	55.03	7.34	13.74	44.98	8.49	18.87			
BL (cm)	F	73.89	3.66	4.96	60.59	3.43	5.66	66.82	3.98	5.96	68.06	6.50	9.56	67.47	6.34	9.39
	M	72.47	4.08	5.63	62.15	3.48	5.60	68.44	4.52	6.60	67.82	8.13	11.99			
WH (cm)	F	79.63	2.22	2.79	73.31	2.35	3.20	75.45	2.65	3.51	72.94	2.90	3.98	75.93	3.94	5.18
	M	80.07	3.72	4.65	74.81	2.72	3.63	76.19	3.61	4.73	75.59	3.22	4.44			
CD (cm)	F	34.60	1.72	4.96	32.52	1.50	4.62	34.03	1.05	3.07	32.88	1.32	4.01	33.56	1.65	4.91
	M	34.10	2.14	6.27	33.07	1.30	3.93	34.07	1.07	3.14	32.53	1.62	4.99			
CW (cm)	F	22.37	1.15	5.13	22.59	1.24	5.49	24.15	0.97	4.03	22.82	0.88	3.87	23.15	1.41	6.09
	M	22.40	1.54	6.90	23.04	1.32	5.71	24.63	1.08	4.38	23.00	0.87	3.77			
HG (cm)	F	97.44	4.64	4.76	92.59	6.33	6.84	100.18	4.37	4.36	90.71	7.04	7.76	96.34	6.97	7.23
	M	96.37	7.04	7.31	95.30	6.13	6.43	103.04	4.77	4.63	90.24	6.12	6.78			
RH (cm)	F	85.41	2.55	2.98	78.76	2.63	3.34	81.27	2.71	3.33	79.76	3.49	4.38	81.91	4.15	5.06
	M	85.87	4.17	4.85	80.63	3.16	3.92	82.44	3.99	4.84	79.35	3.95	4.98			
WFG (cm)	F	11.04	0.44	3.96	10.07	0.42	4.14	10.00	0.33	3.31	10.35	0.55	5.34	10.53	0.63	5.98
	M	11.32	0.44	3.93	10.39	0.45	4.29	10.57	0.47	4.29	10.59	0.67	6.30			

Body length (BL), wither height (WH), chest depth (CD), chest width (CW), heart girth (HG), rump height (RH), front wrist girth (FWG), (X̄): mean, SD: Standard deviation, CV: Coefficient of variation, S: Sex, F: Female, M: Male, MC: Morphological characters

Table 6. Variance analysis and multiple comparison test results of Eastern Anatolian Red calves reared under ex-situ conditions in weaning period.

MC	Overall	Sex ($\bar{X}\pm S_{\bar{x}}$)			Birth year ($\bar{X}\pm S_{\bar{x}}$)				
		Female	Male	p-value	2019	2020	2021	2022	p-value
WW (kg)	50.92±0.53	49.06±0.69	51.32±0.67	0.020	58.81^{a}±1.00	47.16^{c}±1.01	52.58^{b}±0.98	45.48^{c}±1.30	0.000
BL (cm)	67.49±0.33	67.71±0.42	68.20±0.41	0.410	73.18^{a}±0.62	61.37^{c}±0.62	67.63^{b}±0.60	67.94^{b}±0.80	0.000
WH (cm)	75.61±0.21	75.02±0.33	75.64±0.32	0.176	79.85^{a}±0.47	74.06^{b}±0.48	75.82^{ab}±0.46	72.77^{c}±0.61	0.000
CD (cm)	33.46±0.10	33.42±0.17	33.40±0.17	0.922	34.35^{ab}±0.25	32.80^{b}±0.25	34.85^{a}±0.24	32.71^{b}±0.32	0.000
CW (cm)	23.11±0.08	22.74±0.12	23.13±0.11	0.017	22.39^{b}±0.17	22.81^{b}±0.17	24.39^{a}±0.17	22.91^{b}±0.22	0.000
HG (cm)	95.67±0.41	94.21±0.53	95.33±0.52	0.135	96.91^{b} ±0.78	93.94^{c} ±0.78	101.61^{a} ±0.76	90.47^{d}±1.00	0.000
RH (cm)	81.66±0.24	80.85±0.34	81.68±0.33	0.083	85.64^{a}±0.50	79.70^{c}±0.50	81.86^{b}±0.49	79.56^{c}±0.63	0.000
FWG (cm)	10.53±0.03	10.28±0.04	10.63±0.04	0.000	11.18^{a}±0.06	10.23^{c}±0.06	10.29^{c}±0.06	10.47^{b}±0.08	0.000

Weaning weight (WW), body length (BL), wither height (WH), chest depth (CD), chest width (CW), heart girth (HG), rump height (RH), front wrist girth (FWG), $\bar{X}$: mean, $S_{\bar{x}}$: Standart error, MC: Morphological character, a-d: values with different letters in the same column are statistically different

Effects of sex and birth season on body measurements of calves were evaluated, for example, Sakar and Zülkadir (2022), Said et al. (2016), Pudra et al. (2014), Bures et al. (2008), Ulutaş et al. (2001), and Ulutaş et al. (1996). The effect of sex in terms of BL in birth are in line with those observations found by Sakar and Zülkadir (2022), Ulutaş et al. (1996) and Said et al. (2016). The effect of sex in terms of BL in birth are in line with those observations found by Sakar and Zülkadir (2022), Ulutaş et al. (1996) and Said et al. (2016), but, our results are numerically higher than the observations of these researchers. Unlike our findings, Yerli Kara (Sakar and Zülkadir, 2022), Aceh (Putra et al., 2014), and EAR (Ulutaş et al., 1996) were reported that WH of EAR calves had lower numerical value compared to this study'. The WH values detected for the Gascon breed was reported higher than our findings (Bures et al., 2008). It was observed significant difference in CG values between calves of this study with different breed calves reared different farm conditions. Our results for CG were considerably higher compared to those reported by Sakar and Zülkadir (2022), Said et al. (2016), Putra et al. (2014), Bures et al. (2008), and Ulutaş et al. (2001). Higher values for FWG are those of EAR reported in this study when compared stating references (Sakar and Zülkadir, 2022).

Due to different the segmented nature of the animal production process, calves are at the most convenient time weaned and then transported directly to a feedlot or backgrounding facility. So weaning age and period in calves has a considerable contribution in the strategy of livestock and plays a vital role in providing activities like breeder selection, live animal, herd renewal to enhance animal production. The higher CV values for WW were those of 2022 year for both males and females (%18.87, %17.76 respectively) on the basis of discussed years. The lowest values were also sighted in 2019 year. While the CV ratio between sexes was higher in 2019 (%15.47 male, %9.64 female), this ratio was close to each other in other years. This result can also be reported for BL, WH, CD, CW, CG and RH. After all, it was reported that EAR calves showed a very differentness during the experimental period and speculated that this may have been a result of effect of years.

There were sex interactions ($p< 0.05$) for WW, CW and FWG in the study. This is in contrast to Sakar and Zülkadir, (2022) and Nahar et al. (2016) who reported that received calves that studed different local breeds had no interaction of sex compared to our result. However Bahashwan (2016) followed Dhofari calves' performance for the 105-d weaning period and noted effect of sex on calf WW. Our finding values were higher than those found in the literature Yerli Kara (Sakar and Zülkadir, 2022), Red Chittagong (Nahar et al., 2016), EAR (Ulutaş et al., 2001) breed calves but are lower to those found by Holstein heifer calves (Wickramasinghe et al., 2022), Braford (Vaz et al., 2020), Droughtmaster x local yellow (Tao et al., 2018), Dhofari (Bahashwan, 2016), Sistani (Bazzi and Ghazaghi, 2011).

The authors hypothesized that BL may be most beneficial longer calves in sustainable livestock. BL value in current study was lower than in Yerli Kara (Sakar and Zülkadir, 2022) and Holstein heifer calves (Wickramasinghe et al., 2022), but partly similar to Southern Chinese Cattle reported by Wang et al. (2020). Also, Tao et al. (2018) reported that was the Droughtmaster x local yellow breed was lower than our findings. The authors reported that WH reaches its maximum at 2019 year, stabile by decreasing after it until the study final. The results were lower than those reported by Sakar and Zülkadir (2022), Wang et al. (2020) and Tao et al. (2018) for different calve values. Sakar And Zülkadir (2022) reported that was consistent on chest girth the effect of sex with our findings for Yerli Kara breed ($p<0.01$). However, the numerical values of this studing were lower than our findings. Wang et al. (2020) reported higher results for Southern Chinese Cattle. Sakar and Zülkadir (2022) reported that noted no effect of sex on WH ($p> 0.05$) by being consistent with our findings. The values that reported high for Holstein heifer calves (Wickramasinghe et al., 2022) and low for Yerli Kara calves (Sakar and Zülkadir, 2022) were different by comparison our findings. Sex was effect on FWG ($p<0.01$), that was consistent with the report of Sakar and Zülkadir (2022). Wang et al. (2020) reported similar values.

5. Conclusion

The increase in studies on EAR breed could result in a modulation of sustainable of animal biodiversity potentially impacting livestock control and efficiency. Although current findings do at a certain level support our hypothesis, it was thought there be a wide interaction between formal protection programmes and status in animal production of EAR breed. Although the CV in the birth weight varied greatly between the years (except 2022), not much variation was observed between the sexes. This determination was also observed for the body measurements

that was studied in this research. In birth period, sex did significantly affect BW, WH, CW, CG, RH and FWG, but didn't BL and CD. All parameters were affected by years. The CV in the weaning weight showed proportionately variance between the years (except 2019), not much variation was observed between the sexes. Body measurements followed a similar course. In weaning, sex did significantly affect BW, WH, CH, CG, RH and FWG, but didn't BL and CD. All parameters were affected by years. In weaning, sex affected BL, WH, CG and RH, years did all parameters. This study showed that the region was the favorable for getting sustainable livestock for the EAR cattle breed. Thus, this breed is a potential resource in terms of both making profitable use of limited resources and fit material for scientific research in the future.

Acknowledgement

This work was supported by T.C. Ministry of Agriculture and Forestry, General Directorate of Agricultural Research and Policies.

Ethical Statement

There is no need to obtain permission from the ethics committee for this study.

Conflicts of Interest

We declare that there is no conflict of interest between us as the article authors.

Authorship Contribution Statement

Concept: Yüksel, S., Karaçuhalılar, A.; Design: Yüksel, S.; Data Collection or Processing: Yüksel, S., Karaçuhalılar, A.; Statistical Analyses: Yüksel, S.; Literature Search: Yüksel, S., Karaçuhalılar, A.; Writing, Review and Editing: Yüksel, S.

References

Alderson, L. (1992). The categorisation of types and breeds of cattle in Europe. *Archivos de Zootecnia*, 41: 325–344.

Bahashwan, S. (2016). Effect of some environmental factors on weaning weight of Dhofari calves. *Livestock Research for Rural Development*, 28(10): 184-191.

Bazzi, H. and Ghazaghi, M. (2011). The Effect of some environmental factors affecting on the weaning weight of Sistani beef calves. *Journal of Animal Vetarinary Advances*, 10(17): 2240-2243.

Bujko, J., Candrak, J., Strapak, P., Zitny, J., Hrncar, C. and Koristek, J. (2019). Evaluation the birth weight of calves in selected herds of Slovak Spotted cattle. *Animal Science and Biotechnologies*, 52(1): 48-51.

Bures, D., Barton, L., Zahradkova, R., Teslik, V. and Fiedlerova, M. (2008). Calving difficulty as related to body weights and measurements of cows and calves in a herd of Gascon breed. *Czech Journal of Animal Science*, 53(5): 187–194.

Duncan, D. B. (1955). Multiple range and multiple F test. *Biometrics*, 11: 1-42.

Edıng, J. H. and Laval, G. (2002). Measuring Genetic Uniqueness in Livestock. In Gene Banks and The Conservation Of Farm Animal Genetic Resources, 3rd ed.; Institute of Animal Science and Health: Lysted, CA, USA, 33–58.

Garcıa-Lamazares, J. L. (2008). The Veterinarian in Bullfighting Shows; Official College of Veterinarians of Leon: Leon, Spain, 210 (In Spanish).

Halimi, A.H., Karaca, C. and Büyüktaş, D. (2023). Evaluation of NASA POWER Climatic Data against Ground-Based Observations in The Mediterranean and Continental Regions of Turkey. *Journal of Tekirdag Agricultural Faculty*, 20(1): 104-114.

Kayastha, R. B., Zaman, G. and Goswami, R. N. (2008). Studies on the birth weight of indigenous cattle of Assam. *Indian Journal of Animal Research*, 42 (3): 230-231.

Koçyiğit, R., Aydın, R., Yanar, M., Güler, O., Diler, A., Avcı, M., Özyürek, S., Kabakcı, D. and Hirik, E. N. (2015). Effects of weaning ages on the growth, feed conversion efficiency and some behavioral traits of Brown Swiss x Eastern Anatolian Red F_1 calves. *Journal of Agricultural Sciences*, 21: 492-499.

Kopuzlu, S., Esenbuga, N., Onenc, A., Macit, M., Yanar, M., Yuksel, S., Ozluturk, A. and Unlu, N. (2018). Effects of slaughter age and muscle type on meat quality characteristics of Eastern Anatolian Red bulls. *Archives Animal Breeding*, 61: 497–504.

Nahar, S., Islam, A. F. M. F., Hoque, M. A. and Bhuiyan, A. K. F. H. (2016). Animal performance of indigenous Red Chittagong cattle in Bangladesh. *Acta Scientiarum Animal Sciences- Maringa*, 38(2): 177-182.

Ozdemır, M. and Dogru, U. (2009). Determination of phylogenetic relationships of Turkish native cattle breeds with other cattle breeds using mitochondrial DNA D-loop sequence polymorphism. *Asian Australasian Journal of Animal Science*, 22(7): 955 – 961.

Özlütürk, A., Esenbuğa, N., Yanar, M., Ünlü, N., Macit, M. and Kopuzlu, S. (2008). The effect of duration of finishing period on the performance, slaughter, carcass, and beef quality characteristics of Eastern Anatolian Red Bulls. *Turkish Journal of Veterinary & Animal Sciences*, 32(6): 441-448.

Özlütürk, A., Güler, O., Yanar, M., Akbulut, Ö., Ünlü, N., Kopuzlu, S. and Biberoğlu, Ö. (2006). The effect of initial age of fattening on the fattening performans and carcass traits of Eastern Anatolian Red cattle reared in eastern Turkey. *Journal of Animal and Veterinary Advances*, 5: 566 - 569.

Özlütürk, A., Tüzemen, N., Yanar, M., Esenbuga, N. and Dursun, E. (2004). Fattening performance, carcass traits and meat quality characteristics of calves sired by Charolais, Simmental and Eastern Anatolian Red sires mated to Eastern Anatolian Red dams. *Meat Science*, 67(3): 463-470.

Putra, W.P. B., Sumadi, S., Hartatik, T. and Saumar, H. (2014). Analysis of newborn calves measurement for early selection analysis in Aceh Bulls at The Breeding Station. *Animal Production*, 16(2): 71-77.

Said, S., Agung, P. P., Putra, W. P. B., Anwar, S., Wulandari, A. S. and Sudiro, A. (2016). Estimation of most probable producing ability value for calf birth's performance in Sumba Ongole cows. *Journal of the Indonesian Tropical Animal Agriculture*, 41(2): 53-60.

Sakar, M. Ç. and Zülkadir, U. (2022). Determination of some growth and development characteristics between birth and twelve months age in Yerli Kara cattle. *Journal of Agricultural Science*, 28(1): 33-39.

Soysal, M. İ., Aksel, M., Tuna Y. T., Genç, S. and Gürcan, E. S. (2016). Establishment of linear type scoring technique in Anatolian Buffalos Raised in Istanbul. *Journal of Tekirdag Agricultural Faculty*, 13(3): 143-155.

SPSS (2004). Statistical Package for the Social Sciences. Inc., 444 Michigan Avenue, Chicago, IL 60611.

Tao, H., Guo, F., Tu, Y., Si, W. B., Xing, Y. C., Huang, D. J. and Diao, Q. Y. (2018). Effect of weaning age on growth performance, feed efficiency, nutrient digestibility and blood-biochemical parameters in Droughtmaster crossbred beef calves. *Asian Australasian Journal of Animal Science*, 31(6): 864-872.

Ulutas, Z., Akbulut, Ö., Tüzemen, N. and Özlütürk, A. (1996). Growth and development in EAR calves weaned in different periods. *Livestocks Studies*, 36 (2): 54-67.

Ulutaş, Z., Saatçi, M. and Özlütürk, A. (2001). Prediction of body weights from body measurements in East Anatolian Red calves. *Atatürk University Journal of Agriculture Faculty*, 32 (1): 61- 65.

Ünlü, N., Yanar, M., Esenbuga, N., Ozluturk, A., Yüksel, S. and Macit, M. (2008). Effect of days on feed on the performance and carcass characteristics of Eastern Anatolian Red young bulls. *Journal Applied Animal Research*, 34: 163–168.

Üresin, E. R. (1936): Studies on Kars dairy farming. T.R. From the Studies of the Higher Institute of Agriculture, No: 14, Ankara.

Vaz, R. Z., Lobato, J. F. P., Restle, J., Conceiçao, V. G. D., Ferreira, O. G. L., Costa, J. L. B. and Eloy, L. R. (2020). Performance of calves born in different periods of the calving season in intensive beef cattle farming. *Brazilian Journal of Veterinary and Animal Science*, 72 (5): 1874 -1880.

Wang, C., Li, D., Yang, J., Xia, Y., Tu, Y., White, R., Gao, H., Diao, Q. and Mao, H. (2020). Weaning performance of beef cattle calves based on concentrate intake. *Animals*, 10(18): 18-31.

Wickramasinghe, J., Kaya, C.A., Beitz, D. and Appuhamy, R. (2022). Early stepdown weaning of dairy calves with glutamine and branched-chain amino acid supplementations. *Animals*, 12: 1474.

Yıldız, N., Aygen, S. and Özçelik, M. (2008). Milk, fertility and body measurements of Eastern Anatolian Red (EAR) cows raised under Elazıg conditions, II. Milk yield characteristics, body measurements, body weight, calf birth weight and viability. *Fırat University Journal of Health Sciences*, 22 (5): 261 – 266 (In Turkish).

Yüksel, S. (2019a). A study on the local situation of the Eastern Anatolian Red (DAK) cattle breed and the effect of breeding methods on some breed characters. *Livestocks Studies*, 59(2): 64 – 71 (In Turkish)

Yüksel, S. (2019b). Effects of housing condition, feeding style, and age on fattening performances, comfort, and some slaughterhouse characteristics in Eastern Anatolian Red bulls. *Turkish Journal of Veterinary and Animal Science*, 43: 650-655.

Yüksel, S., Karaçuhalılar, A., Balta, B., Şimşek, U., Yüksel, F., Memiş, M. and Çelik, M. (2021). The effect of age, birth weight and milk suction time on some carcass characteristics and Load Distribution Ratio (LDR): Eastern Anatolian Red Cattle Example In Turkey. *Journal of Agricultural Sciences (Belgrade*), 66(1): 53-65.

Yüksel, S., Karaçuhalılar, A., Yüksel, F. and Balta, B. (2019). Effect of housing condition, feding style anda ge on meat colour, and some carcass characteristics in Eastern Anatolian Red bulls. *Turkish Journal of Agriculture - Food Science and Technology*, 7(5): 750-756.

Yüksel, S., Yanar, M., Aksu, M.İ., Kopuzlu, S., Kaban, G., Sezgin, E. and Öz, F. (2012). Effects of different finishing systems on carcass traits, fatty acid composition, and beef quality characteristics of young Eastern Anatolian Red bulls. *Tropical Animal Health And Production*, 44: 1524 - 1528.