Turkish Journal of Veterinary & Animal Sciences

Volume 48 | Number 3 Article 4

2024

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ADİL UZTEMUR

ABDÜLKADİR ORMAN

TÜBİTAK

Turkish Journal of Veterinary and Animal Sciences

http://journals.tubitak.gov.tr/veterinary/

Research Article

Turk J Vet Anim Sci
(2024) 48: 150-155
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doi:10.55730/1300-0128.4348

Features of lying behavior of *Gazella marica* fawns in semicaptive conditions

Adil UZTEMUR*, Abdülkadir ORMAN
Department of Animal Science, Faculty of Veterinary Medicine, University of Bursa Uludağ, Bursa, Turkiye

Received: 04.09.2023 • **Accepted/Published Online:** 13.04.2024 • **Final Version:** 05.06.2024

Abstract: The lying behavior of *Gazella marica* fawns was investigated in the gazelle breeding station established to prevent the extinction of this species, whose numbers are decreasing continuously in the wild. There are significant differences between the lying duration in the bedding sites of different kinds (plant-based site, soil-based, side of a stone or rock). *Gazella marica* fawns were lying on one side of the body 50.23 min on average in the plant-based bed sites, 36.06 min in the soil-based places, and 38.14 min in the stone/rock area. *Gazella marica* fawns from semicaptive conditions lied on one body side longer compared to *Gazella subgutturosa* fawns in the wild. During May 15–31 *Gazella marica* fawns preferred the plant-based bed sides, significantly less the soil-based and stone/rock areas. *Gazella marica* fawns were lying in sunny places in the plant-based and soil-based bed sides, while in the stone/rock areas they were laying more in the shaded places. *Gazella marica* fawns were laying in sunny areas from mid-May until the end of July, while during August, they preferred the shaded places. In general, the lying duration was different: *Gazella marica* had longer one-bodyside laying duration in the semicaptive conditions than *Gazella subgutturosa* fawns in the wild, though both species prefer likely most comfortable bedding sites. The reason of this difference likely related to antipredator behavior, when *Gazella marica* fawns, protected by fence against any predation case, feel safer and can rest longer, while *Gazella subgutturosa* fawns in the wild have additional impact of predation danger and therefore, they change the body sides more often during the rest due to have opportunity for additional vigilance.

Key words: Gazella marica, bedding preference, lying time, bedding place

1. Introduction

The Arabian sand gazelle (*Gazella marica*) is native to Saudi Arabia, the United Arab Emirates, Oman, Jordan and the area along the southeastern border of Türkiye [1]. According to IUCN red list data, the number of mature *Gazella marica* in the wild is between 1750 and 2150 individuals [2]. The number of *Gazella marica* in Türkiye is around 320 in the wild. In captivity, there are more than 2000 according to results of the last census. [3]. Wild Animal Breeding Stations have been established in Türkiye in order to breed wild animals, which are in danger of extinction, and to release them back to wildlife. In 2020 and 2021, *Gazella marica* were transferred from Şanlıurfa (gazella breeding station) to Şırnak (wildlife) in Türkiye under the *Gazella marica* reintroduction program and their reproduction was ensured [4].

Many wild mammals (deer, gazella, goat, etc.) in the northern hemisphere give birth in March and May [5]. In the first weeks after birth, fawn of *Gazella subgutturosa* spend most of the day lying down, except for feeding and small activities [6]. It has been reported that the location of the bedding place for mammalian young with weak resistance is very important in endurance to adverse weather conditions [7,8]. It also plays an important role in hiding offspring from predators [9–11]. The ungulate species prepare their bedding place before lying, scraping, and removing the stones, branches, and different objects with their hooves. In studies on cattle, the time spent lying on the bedding is highly dependent on the bedding material provided for the cattle. It has been determined that cows prefer softer materials for lying down and lie on these materials longer [12–14]. However, some wild sheep and Himalayan tahr scratch soft surfaces with their hooves instead of hard surfaces [15]. *Gazella subgutturosa* fawns spend an average of 7.7 s to prepare their bedding. While lying down during resting, gazelles change their body positions periodically, sometimes every five minutes and sometimes until 3 h. Adult *Gazella subgutturosa* males lie on one side of their bodies average of 29.9 min and adult *Gazella subgutturosa* females an average of 30.3 min. However, *Gazella subgutturosa* fawns lie on one side of their body a little less than adults, by average of 27.9 min [6]. Gazelles prefer to lie in shaded and wooded areas to be protected from sunny and hot weather [6]. All year round, goitered gazelles preferred dry riverbeds for resting more than other places. Since the ground of the dry riverbeds are

* Correspondence: vet.hek.adiluztemur@gmail.com

sand, it is easier to prepare the bedding place [6]. Based on the studies on the lying behavior of *Gazella subgutturosa* fawns in the wild, the following questions were formed to determine the lying behavior of *Gazella marica* fawns in the wild animal breeding station.

Is the resting behavior (lying duration and bedding preference) of Gazella marica fawns in the semicaptive conditions of our breeding station similar or different compared to *Gazella subgutturosa* fawns in the wild? What are the preferences of bedding sites in the juveniles of Gazella marica in the breeding station over months (May 15–31 to August 1–31)?

By answering these questions, it has been succeeded with this study what the similarities and differences between the lying behaviors between *Gazella subgutturosa* fawns in the wild and *Gazella marica* fawns are in the wild animal breeding station. We hypothesized that *Gazella marica* juveniles would have the same lying, resting times and bedding preferences as *Gazella subgutturosa* juveniles demonstrate.

2. Materials and methods

2.1. Study area and instruments

This study was made at Kızılkuyu gazelle breeding station in Şanlıurfa province in Türkiye. Gazelle Breeding Station (37°02'N-38°42'E), which consists of an area of 22.72 ha surrounded by wire fences. The altitude of this area varies between 545–600 m ASL. The average annual temperature is 18.5 °C (highest 46.8 °C lowest–12.4 °C) Annual precipitation average is 463.3 mm. Its location was measured using the Magellan explorist 610 model GPS and Google Eart [4]. The Gazella Breeding Station is situated in the steppe area. Therefore, there are no trees and other objects that give shade. Only stones and rocks have shaded places for the rest. No grouping was made within the herd. All gazelles were interacting with each other within the same herd.

The following instruments; Swarovski EL 10X42 binoculars, Swarovski ATX 25-60X85 telescope, Canon EOS 1300 D and lens 18–55, 75-300 camera, Redmi note 8 (for photo, video and time recording) mobile phone, for chronometer Mi Band 4 (digital wrist watch) have been used for the study.

2.2. Study program and data collection

Observations were started with the onset of births. First birth was in May 11. Observations were made only during the daytime between 08:00 and 17:00 per day. Observation duration varied between 6 h and 9 h daily. During the observation period, 77 h of observation were made in May, 134 h in June, 129 h in July, and 61 h in August. We did the focal observations from the tower using binoculars and telescope. A vehicle was not used. Resting behaviors of fawns were examined during period from May 15 until August 31.

2.3. Methods

The focal animal observation method was used [16,17]. For the obtain correct results, the entire herd was marked with individual ear tags in 2020–2021 for individual identification. The ear tags are the same size and features as the sheep and goat earrings. Used earrings had two kinds of size and weight, specifically for males and another for females. Technical specifications of the female part: width 31 mm, length 43 mm, weight 3.00 g, material plastic. Male part: width 31 mm, length 35 mm, weight 2.00 g, material plastic. If smaller earrings were used, it would be difficult to read and identify the animal's ear tags from afar during observation. Therefore, these earrings increased our chances to follow more mothers and fawns during our observations and obtain more data from different gazelle families. We collected data for 415 individuals, allowing us to obtain strong results for the fawn bedding behavior. We selected fawns for our observations randomly and follow them until they were disappearing from our view.

2.4. Lying behavior

The resting places used by offspring and adult gazelles were within the area surrounded by wire fence in the production station. During our observation period, totally 415 juvenile gazelles were observed to lie down, including 138 individuals in May 15–31, 143 individuals in June 1–30, 112 individuals in July 1–31 and 22 individuals in August 1–31. The ethogram of observed behaviors such as bedding preference, resting in a shaded place and bedding place is presented in Table 1 [6].

2.5. Statistical analysis

The one-way Anova and post hoc Tukey tests were applied to find out changing (preferring) of bedding place types, and the relationship between lying duration on one side of the body according bedding preference since the data showed not normal distribution according to the Shapiro-Wilk. In addition, whether the juvenile gazelles' preferences for bedding preference changed over months were analyzed. Pearson chi square test has been used in the analysis of proportional data (bedding preference, bedding place, resting in a shaded place, date). For example, on which dates, did they prefer to lie down in the shadiest places? This test was used to find out which bedding places they used more on which dates.

Significance level was taken as $p < 0.05$. All data were analyzed using IBM SPSS Statistics for Windows (Version 28.0. Armonk, NY: IBM Corp).

3. Results

Gazella marica fawns were lying on the same body side in a plant-based bedding during 50.23 min in average, 36.06 min in a soil-based places, and 38.14 min in the area of stones/rocks. There are significant differences between lying duration in the different kinds of bedding sites [F (2,

Table 1. Descriptions of gazelle lying behavior.

Behavior examples	Explanation
Bedding preference	The areas the gazelle prefers to lie down. These are respectively; 1-Plant-based bedding: Where found Phlomis bruguieri, Medicago sativa, Poaceae, etc. 2- Soil-based bedding: The surface of the bedding ground is the area covered with soil. This area is generally created by gazelles by pawing with their hooves or naturally found in the Breeding Station. 3- The side of a stone or rock: The lower parts of the concrete block under the wire are included in this group, as well as lying on the side of the stones and rocks naturally found in the Breeding Station.
Resting in a shady place	To be protected from the direct effects of the sun's rays in hot periods, a gazelle tries to find a shaded place in the field, under the rock bottoms, in the high grass and under the concrete blocks at the bottom of the wire fence.
Bedding place	Old: Gazelles use the same bedding to rest and lie down New: Gazelles use their bedding for the first time to rest and lie down
Lying time on one side of the body	It is the time that the juvenile gazelle spends in its bedding place, lying down one side of their body, periodically changing body sides from body right to left and back.

412) = 5.50, p = 0.004] (Table 2). *Gazella marica* fawns lied on one side of the bodies' longest time in the plant-based bedding compared to other types of bedding sites.

Fawns preferred different bedding sites in different months (May 15–31, June 1–30, July 1–31 and August 1–31) and bedding preferences (plant-based bed sites, soil based bed sites and Stone/rock area) [$\chi^2(6, N = 415) = 139{,}939$, $p < 0.001$]. In May 15–31, juvenile gazelles were more preferred the plant-based bed site, and less soil-based bed sites and the stone/rock areas. In June 1–30, they have preferred soil-based bed site more. In July 1–31, *Gazella marica* fawns have preferred the side of a stone or rock more than plant-based bedding, followed by the most soil bedding (Figure 1).

There is a significant difference between bedding preference and bedding place [$\chi^2(2, N = 415) = 200{,}847$, $p < 0.001$]. *Gazella marica* fawns have preferred the new bedding in the plant-based bedding more than the old bedding. Old bedding was preferred in soil-based bedding. On the side of a stone or rock, they also preferred the old bedding more (Figure 2).

There is a significant difference between resting in sunny and shaded places by months [$\chi^2(3, N = 415) = 81{,}250$, $p < 0.001$]. *Gazella marica* fawns have lied more in unshaded areas between May 15–31, June 1–30, July 1–31. During August 1–31 juvenile gazelles were lying more in shaded areas (Table 3). There is a significant difference between bedding preference and resting in a shaded place [$\chi^2(2, N = 415) = 139{,}512$, $p < 0.001$]. *Gazella marica* fawns have often lied in unshaded areas in plant-based bedding and soil-based bedding. On the side of a stone or a rock, they have lied more in the shaded area (Table 4).

4. Discussion

Our results did not support our hypothesis. Our results in lying duration on the same body side were different from Blank's [6] results. According to Blank [6], *Gazella subgutturosa* juveniles have lied on one side of the body for an average of 27.9 min. However, in the results we obtained, the duration of lying on one side of the body was higher depending on the bedding areas. This time has been found to be 50.23 min on average in bedding with plant-based bedding, 36.06 min on average in bedding with soil-based bedding and 38.14 min on the side of a stone or a rock. *Gazella marica* fawns have a longer time to lie down on one side of the body than *Gazella subgutturosa* fawns. It has been reported that cows prefer softer materials foresting and lie on these soft materials longer [12–14]. Since the plant-based bed site where the juvenile *Gazella marica* lie down is softer than the other bed site places, it has been determined that they lie in the plant-based bed site for an average of 50.23 min and lie down for longer than the other bed site. It is also supported by our findings that the lying time is longer in soft-bed mattresses. According to Blank [6] goitered gazelles preferred dry riverbeds more than other bedding all year round for resting. Since the ground of the dry riverbeds is sand, it is easier to prepare the bedding place. However, since the wild animal breeding station is a closed area, its bedding places are also limited. According to our results, compared to *G. subguttrosa*, *Gazella marica* fawns stayed longer in a different bedding places in any month. In May 15–31, *Gazella marica* fawns preferred to stay in the plant-based bedding the most. This shows that the plants are softer for both hiding and bedding during the first weeks

Table 2. Lying duration on one side of the body (minutes).

Bedding preference	Number of individuals	Average	Standard deviation	Standard error	Minimum	Maximum
Plant-based bed sites[a]	161	50.23	56.87	4.48	1	340
Soil-based bed sites[b]	170	36.06	24.20	1.85	3	113
Side of a stone or a rock[ab]	84	38.14	27.77	3.03	2	129
Total	415	41.98	41.085	2.017	1	340

a, b: The mean difference is significant p = 0.005

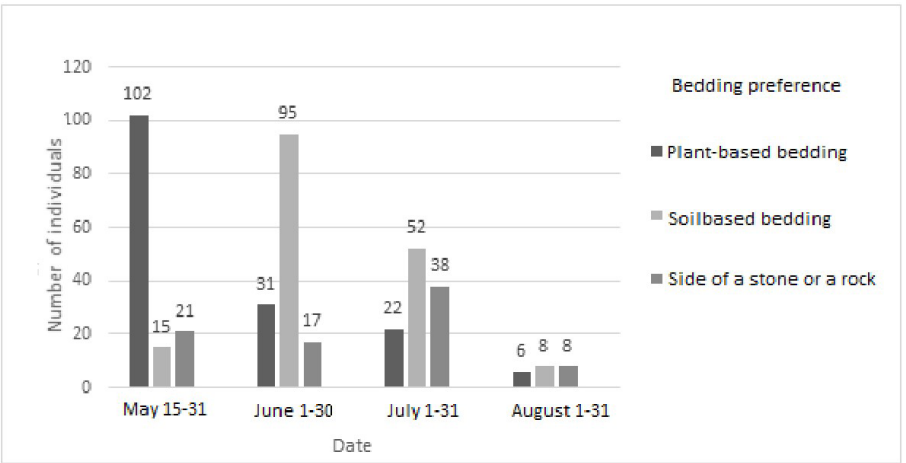

Figure 1. Changing of bedding condition preference over months.

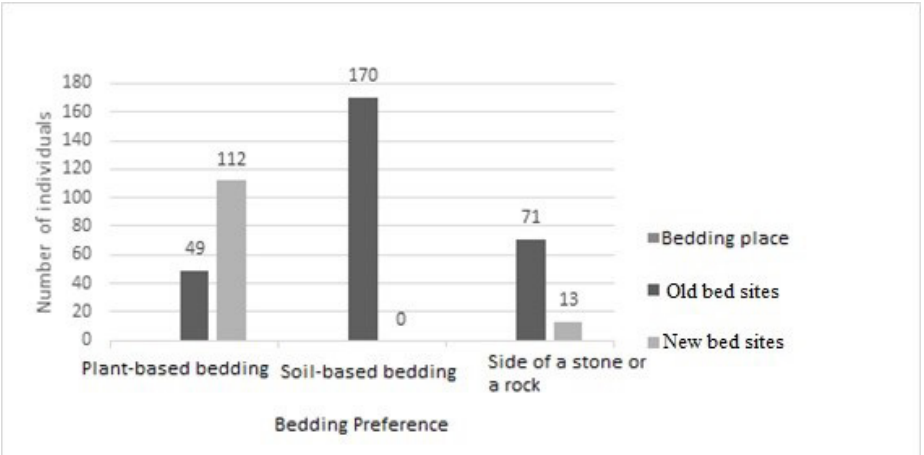

Figure 2. Changing in fawn's preference according to bed site conditions.

after birth. It has been reported that the gazelle fawns hide from predators in plants during their first weeks of their life [11]. According to our results, we thought that the *Gazella subgutturosa* fawns use the plant based beds also for hiding. However, with warming weather in June and July, *Gazella marica* fawns preferred soil-based bed sites than other kinds. It shows similar behavior with *Gazella subgutturosa* fawns that prefer dry riverbeds [6]. *Gazella marica* fawns preferred the newest bedding place in the plant-based bedding. In addition, the preference of the old bedding of the soil-based bedding shows that the bedding place is prepared more easily because the ground of the

Table 3. Changing of fawn's preference of shady places over months.

		Resting in a shady place		Total	p	value
		Yes	No			
Date	May 15–31	10	128	138	<0.001	81.250
	June 1–30	21	122	143		
	July 1–31	53	59	112		
	August 1–31	14	8	22		
Total		98	317	415		

Table 4. Fawn's preference of shady places in different bed site conditions.

		Resting in a shady place		Total	p	value
		Yes	No			
Bedding preference	Plant-based bed sites	9	152	161	<0.001	139.512
	Soil-based bed sites	29	141	170		
	Side of a stone or a rock	60	24	84		
Total		98	317	415		

bedding area is soil. It supports the view of Blank's [6] dry riverbeds are easier to prepare for the soil ground for the bedding. Also, dry riverbeds are soft to lie down because the ground is soil. On the side of a stone or rock, *Gazella marica* fawns preferred the old bedding places more than the new bedding places. Because the old bedding areas are mostly shaded areas, it has been seen that these places are constantly used to protect from heat and sun. Adults and juvenile of *Gazella subgutturosa* prefer shaded areas to be protected from the effects of the sun in hot weather and to keep the body temperature in balance [6]. Depending on the warming of the weather, *Gazella marica* fawns preferred to sleep in shaded areas. In addition, the side of a stone and rock is more preferred as a shaded area. It is seen that our results are similar to Blank [6,18].

As a result, *Gazella marica* fawns, like *Gazella subgutturosa* fawns in wild, have preferred that their bedding is comfortable for bedding places. Also, since the lying behavior of *Gazella marica* fawns was not studied, we could not make comparisons over the same species. However, when we thought that it was close to *Gazella subgutturosa*, we thought it would be more understandable to make our comparisons in this direction. However, the fact that the *Gazella marica* fawns in the wild animal breeding station have a longer lying time on the side of body than the *Gazella subgutturosa* fawns in the wild suggests that they feel safe and lying longer. But prolonged lying time will make them more vulnerable to hunters and predators. This will make it difficult for them to adapt when they are release to wild. In addition, it is necessary to examine the behaviors such as social behaviors as well as sleeping behavior in *Gazella marica* fawns and compare them with the studies conducted with *Gazella subgutturosa* fawns in the wild to find out their similarities and differences. In this way, the *Gazella marica* in the wild animal breeding station should try to maintain its natural behavior in the wild. In addition, *Gazella marica* should adapt easily when released back to the natural wildlife.

Acknowledgment
I would like to thank the Ministry of Agriculture and Forestry General Directorate of Nature Conservation and National Parks for the planning, realization and management of this study. This study is a summary of the PhD thesis by Adil UZTEMUR

Ethical standards
Ethical approval: The research permissions were obtained with the letter dated 04.02.2022 and numbered E-21264211-288.04-4403818 from the Ministry of Agriculture and Forestry, General Directorate of Nature Conservation and National Parks.

Animal welfare
The authors confirm that they have adhered to ARRIVE Guidelines to protect animals used for scientific purposes.

Declarations Competing interests
No

Authors' contributions
AU: Field work and data collect, AO: Statistical analyze, AU and AO: Writing manuscript.

Funding
This research received no grant from any funding agency/ sector.

Availability of data and materials
The data results obtained in this study are available from the corresponding author and first author upon request.

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