

Parasites Detected in Hatay Mountain Gazelles (*Gazella gazella*)Hatay Dağ Ceylanları'nda (*Gazella gazella*) Tespit Edilen Parazitler

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Abstract: The current study aimed to detect parasites in Hatay Mountain Gazelles (*Gazella gazella*), which are categorized as endangered according to the International Union for Conservation of Nature. The present study was conducted in Hatay Mountain Gazelle Wildlife Development Area, where 40 gazelles inhabited (30 ♀, 10 ♂), 15 of which were over three years old as well-considered adults. Fecal samples were taken from 60 fecal foci immediately after the defecation of the gazelles. Each of the fecal samples was analysed with Benedek sedimentation, Fülleborn flotation and Bearman-Wetzel methods and examined under a light microscope. In addition, Ixodid ticks were collected from an injured gazelle which was brought to Hatay Mustafa Kemal University, Wildlife Rescue and Rehabilitation Center, then were identified under the stereomicroscope. *Nematodirus* spp. (5/60, 8%), *Marshallagia* spp. (4/60, 7%), *Trichostrongylus* spp. (3/60, 5%) eggs, *Dictyocaulus filaria* larvae (3/60, 5%) and *Eimeria* spp. oocysts (9/60, 15%) were determined based on the microscopic examination. Ixodid tick samples were identified as *Rhipicephalus turanicus* (2 ♀, 3 ♂). Thus this is the first report of the existence of parasites in Hatay Mountain Gazelles in Turkey. It is thought that skin and fecal examinations should be performed to prevent parasitic diseases in gazelles.

Keywords: Endangered, *Gazella gazella*, Hatay Mountain Gazelle, parasite

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Öz: Sunulan çalışmada, Uluslararası Doğayı Koruma Birliği'ne göre nesli tehlike altında olarak sınıflandırılan Hatay Dağ Ceylanları'ndaki (*Gazella gazella*) parazitlerin tespit edilmesi amaçlanmıştır. Çalışma, Hatay Dağ Ceylanları Yaban Hayatı Geliştirme Sahası'nda, 15 tanesi 3 yaşın üstünde ve ergin kabul edilen 40 adet (30 ♀, 10 ♂) ceylanın yaşadığı arazide yapılmıştır. Ceylanların dışkılamaları takip edilerek 60 adet dışkı odağından dışkı örnekleri alınmıştır. Örneklerin her biri, Benedek sedimentasyon, Fülleborn flotasyon, Bearman-Wetzel metodları ile analiz edilerek ışık mikroskobu altında incelenmiştir. Ayrıca Hatay Mustafa Kemal Üniversitesi, Yaban Hayvanı Kurtarma ve Rehabilitasyon Merkezi'ne getirilen yaralı bir ceylandan toplanan Ixodid keneler stereomikroskopta teşhis edilmiştir. Dışkı örneklerinin mikroskopik muayenesinde; *Nematodirus* spp. (5/60, %8), *Marshallagia* spp. (4/60, %7), *Trichostrongylus* spp. yumurtalarına (3/60, %5), *Dictyocaulus filaria* larvalarına (3/60, %5) ve *Eimeria* spp. oocistlerine (9/60, %15) rastlanmıştır. Ixodid kene örnekleri ise *Rhipicephalus turanicus* (2 ♀, 3 ♂) olarak teşhis edilmiştir. Bu çalışmayla Türkiye'de Hatay Dağ Ceylanları'nda parazitlerin varlığı ilk kez kayıt altına alınmıştır. Ceylanlarda paraziter kaynaklı hastalık oluşumunun önlenmesi için deri ve dışkı muayenelerinin yapılması gerektiği düşünülmektedir.

Anahtar Kelimeler: nesli tükenmekte olan, *Gazella gazella*, Hatay Dağ Ceylanı, parazit

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INTRODUCTION

There are 173 mammal species belonging to 36 families in Turkey, which is very rich in terms of biological diversity (Karataş et al., 2021) and some of these species are categorized as endangered or below, according to the International Union for Conservation of Nature. Gazelles are placed in the family Bovidae, subfamily Antilopinae (antelopes). Sand gazelle (*Gazella marica*) and Mountain Gazelle (*Gazella gazella*), which are among the gazelle species in Turkey, are classified as vulnerable and endangered species, respectively (İlaslan, 2019; Karataş et al., 2021). Mountain Gazelle (*Gazella gazella*), which lives in hilly areas and steep slopes with arid and semi-arid climate, is now widespread in the Golan Heights in Israel and Palestine, Central Israel, Jordan Valley and the northern Negev. A small population of these gazelles inhabits the area close to the Syrian border in the Kırıkhan-İncirli settlement of Hatay province in Turkey, and they are called Hatay Mountain Gazelle in the region (Ergün et al., 2010; Hadas et al., 2015; İlaslan, 2019; Kankiliç et al., 2012). These gazelles have a slender body structure in proportion to their long neck and legs, and also have dark bands on their face, flanks and haunches. The lower and lateral parts of their bodies are white; the limbs are light brown, and the body is dark brown. Hatay Mountain Gazelles are sexually dimorphic. Adult males are larger than females, and their horns are more structured with distinctive rings (Mendelssohn et al., 1995).

The number of gazelles, which constitute an important part of wildlife in the world, can decrease rapidly due to diseases (Shimshony et al., 1986), hunting, heavy pesticide use, deterioration of their habitats, and capture for trade (Gürler et al., 2015; Kankiliç et al., 2012). Helminth infections affecting the liver, lungs and gastrointestinal system are common in gazelles (Saud et al., 2012). Ectoparasitic infestations such as myiasis, lice, fleas, ticks, and scabies are also encountered (Yeruham et al., 1999). Parasitic diseases have a remarkable impact on wildlife. These diseases may cause symptoms such as weight loss, fatigue, diarrhea, scruffy hair, submandibular edema in gazelles which are captivated and exposed to stress conditions (Mohammed et al., 2007; Saud et al., 2012). Furthermore, they may lead to economic losses, a decrease in animal productivity and herd immunity, and even death in severe infections (Ortiz et al., 2006).

This study aimed to detect the parasites in Hatay Mountain Gazelles using microscopic and morphological methods.

MATERIAL AND METHOD

This research was approved by the Animal Ethical Committee of Hatay Mustafa Kemal University (decision no: 2021/06-09).

Study Site

Kırıkhan is a district of Hatay in Southern Anatolia (36°29'N, 36°21'E) and has a mild Mediterranean climate. This study was conducted in the Hatay Mountain Gazelle Wildlife Development Area, which is known to host 40 Hatay Mountain Gazelles. This place is located in an isolated area of 120 decares surrounded by wires in Kırıkhan, İncirli village, which is and stated on the borderline of 10-12 km to Syria in a mountainous region of approximately 15,000 hectares and estimated to host 1200 Hatay Mountain Gazelle. In this area, which is surrounded by wires, only Hatay Mountain Gazelles live, except for animals such as rabbits, snakes, moles, voles and wild birds that cannot be prevented from entering the field. Gazelles usually herd in threes and eights (Can, 2019; İlaslan, 2019) and gather around feeding racks and water troughs placed at the entrance and in the middle of the isolated area for feeding and drinking water (Figure 1).



Figure 1. Hatay Mountain Gazelles (*Gazella gazella*) in the Wildlife Development Area.
Şekil 1. Yaban Hayatı Geliştirme Sahası'ndaki Hatay Dağ Ceylanları(*Gazella gazella*).

Collection of Samples

The materials of this study consisted of fecal samples were obtained from Hatay Mountain Gazelle Wildlife Development Area between March and May 2021 and Ixodid ticks were collected from an injured gazelle which brought to Hatay Mustafa Kemal University, Wildlife Rescue and Rehabilitation Center. There were 40 gazelles (30 ♀, 10 ♂) in the area, 15 of which were over 3 years old and considered as adults. Fecal samples were taken from 60 fecal foci which belong to 40 gazelles state in the area. Fecal samples and ticks were collected by the veterinarian in charge. It was informed that gazelles were not administered any drugs or anthelmintic because their general clinical condition was good and they were difficult to catch.

Fresh fecal samples were taken from 60 fecal foci without touching the soil part by following the defecations of the gazelles. Samples were collected using disposable gloves in 50 gram sterile sealed plastic containers marked with a protocol number, and transported in the cold chain to the Department of Parasitology, Faculty of Veterinary Medicine, Hatay Mustafa Kemal University. The collected Ixodid tick samples were preserved in a glass bottle containing 70% ethyl alcohol.

Microscopic Analysis

Ixodid tick samples were examined under a stereomicroscope. Each of the fecal samples was analyzed by Benedek sedimentation, Fülleborn flotation, Bearman-Wetzel methods and investigated for parasitic forms under the light microscope. The helminth eggs, protozoan oocysts and tick species were morphologically identified according to the relevant literature (Dantas-Torres et al., 2017; Gürlü, 2016; Saud et al., 2012). 2% K₂Cr₂O₇ was added to *Eimeria* positive fecal samples and exposed to sporulation under laboratory conditions.

RESULTS AND DISCUSSION

Of the 60 fecal samples obtained from fecal foci of Hatay Mountain Gazelles tested, 24 (40%) were found to be infected with parasitic forms. 36 (60%) of the fecal samples were negative. *Eimeria* spp. oocysts (9/60, 15%) were determined to be the most common parasitic form, followed by *Nematodirus* spp. (5/60, 8%), *Marshallagia* spp. (4/60, 7%), *Trichostrongylus* spp. (3/60, 5%) eggs, *Dictyocaulus filaria* larvae (3/60, 5%) based on the microscopic examination of feces (Figure 2). Although ultimate attention has been shown to collect fecal samples fresh, it was observed that larvae and spores developed in eggs and oocysts, respectively, in a few samples. The collected Ixodid ticks were identified as *Rhipicephalus turanicus* (2 ♀, 3 ♂).

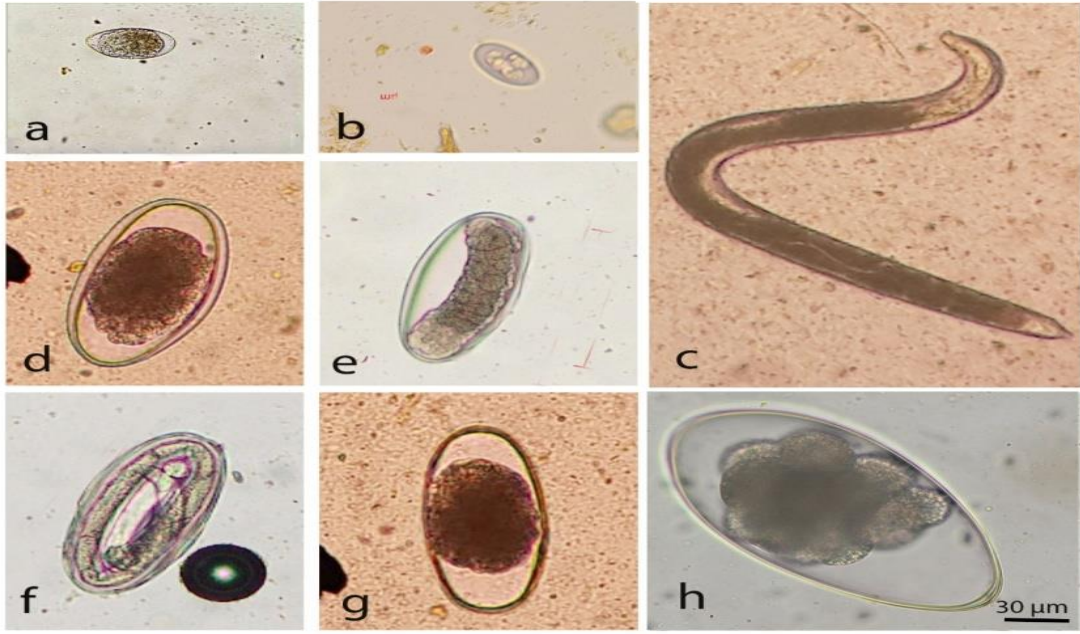


Figure 2. Parasitic forms detected in fecal samples of Hatay Mountain Gazelles.

a-b) Non-sporulated and sporulated *Eimeria* spp. oocyst, c) Larvae of *Dictyocaulus filaria*, d-e) Embryonated and non-embryonated eggs of *Marshallagia* spp., f-g) Embryonated and non-embryonated eggs of *Trichostrongylus* spp., h) *Nematodirus* spp. egg (Scale bar for egg and oocyst: 30 µm).

Şekil 2. Hatay Dağ Ceylanları'nın dışkı örneklerinde tespit edilen parazit formları.

a-b) sporlanmamış ve sporlanmış *Eimeria* spp. oocisti, c) *Dictyocaulus filaria* larva, d-e) *Marshallagia* spp larvalanmamış ve larvalanmış yumurta, f-g) *Trichostrongylus* spp. larvalanmamış ve larvalanmış yumurta, h) *Nematodirus* spp. yumurta (Yumurta ve oocistler için ölçü çubuğu: 30 µm).

The knowledge about the parasitic fauna of gazelles is expanding. Various parasitic infections have been detected in different gazelle species in the world. Some of these infections are associated with helminths (Ashor, 2009; Baghi et al., 2016; Eslami et al., 1981; Modabbernia et al., 2021; Saud et al., 2012). Protozoan infections linked with *Eimeria* species (Ashor, 2009; Baghi et al., 2016; Mohammed, 2002; Saud et al., 2012) also have been reported in previous studies. The most prevalent helminth infections are caused by nematodes, particularly gastrointestinal nematodes (Ashor, 2009; Baghi et al., 2016; Kolapo and Jegede, 2017; Modabbernia et al., 2021; Saud et al., 2012). *Rhipicephalus turanicus* from Ixodid ticks, which is known to infest domestic and wild animals as hosts for their developmental stage (Chochlakis et al., 2014), was recorded in large numbers (128 ♀, 161 ♂) on 222 gazelles in Israel (Yeruham et al., 1999), was found on an injured Mountain Gazelle (2 ♀, 3 ♂) in this study. Several gastrointestinal nematodes such as *Teladorsagia* (Yilmaz, 2021), *Nematodirus*, *Ostertagia* and *Trichostrongylus* species (Altas and Iriadam, 2004), cestodes such as hydatid cyst (Sağlam et al., 2011), protozoans such as *Toxoplasma* (Gokcen et al., 2007) and *Eimeria* species (Altas and Iriadam, 2004) were encountered in different gazelle species in Turkey. Besides these, a number of ectoparasitic infections including genital and cutaneous myiasis caused by *Lucilia sericata* (Gokcen and Sevgili, 2007; Sevgili et al., 2004) and sarcoptic mange (Kurtdeede et al., 2007) were also reported in aforementioned gazelles.

Gastrointestinal nematodes are widespread helminths in cattle, sheep, goats and wild ruminants grazing on the same pasture all over the world. Wild ruminants are more likely to be infected with gastrointestinal nematodes in comparison with domestic ruminants (Carrau et al., 2021). Previous studies have reported that gazelles were concurrently infected with gastrointestinal nematodes including the members of the genera; *Haemonchus*, *Ostertagia*, *Teladorsagia*, *Marshallagia*, *Camelostrongylus*, *Trichostrongylus*, *Cooperia*, *Nematodirus*, *Nematodirella* belonging to superfamily Trichostrongyloidea (Baghi et al., 2016; Goossens et al., 2005; Modabbernia et al., 2021; Ortiz et al., 2006; Saud et al., 2012). In these cases of multiparasitism, *Nematodirus* species were more dominant compared to other gastrointestinal nematodes because their eggs

are more resistant to environmental conditions (Eslami et al., 1980; Ortiz et al., 2001, 2006; Saud et al., 2012). In this study carried out in Hatay Mountain Gazelles in the isolated region, the findings of different species such as *Nematodirus* (8%), *Marshallagia* spp. (7%) and *Trichostrongylus* (5%), and the fact that *Nematodirus* was the most abundant species, are compatible with those determinations. Gastrointestinal nematode species and *Eimeria* oocysts stated in this study were also observed in *Gazella subgutturosa* in Şanlıurfa (Altas and Iriadam, 2004). In addition to that *D. filaria* and *Rh. turanicus* were detected in Hatay Mountain Gazelles.

Parasitic infections are subclinical in wild animals due to premunity against parasites. Mir et al. 2016 reported that disease may occur if the balance between parasite and host resistance is disrupted by reason of isolation and stress conditions of wild animals. In the current study, isolated Mountain Gazelles, whose feces were examined, appeared to be clinically healthy. It can be attributed to the that gazelles were exposed to an inconsiderable amount of disease agents originating from the pasture and the stress conditions did not occur at the level to cause illness.

Lungworms belonging to the family Protostrongylidae infect a wide range of domestic and wild animals. Some of these parasites are causative agents of pneumonia but also can damage lung tissue and lead to secondary infections (Saidi et al., 2020b). Weight loss, respiratory discomfort, reduction in reproductive performance and death occur associated with these nematodes (Panayotova-Pencheva and Alexandrov, 2010). *Muellerius capillaris* and *Neostrongylus linearis* species of lungworms have been reported in 60 gazelles (*Gazella dorcas*) in Morocco (Saidi et al., 2020b) whereas there were no lungworms in the necropsy of 24 gazelles (*Gazella subgutturosa*) in Iran (Modabbernia et al., 2021). In this study, *D. filaria*, which is frequently found in sheep and goats but can also be seen in wild ruminants (López and Martinson, 2017) was determined.

Eimeria species are intestinal protozoa with the host specificity and variable degree of pathogenicity worldwide. It has been reported that *Gazella* spp., which shows herding behaviour as compared with other antelope species, become more susceptible to such infections, especially under stress conditions because of the limitation of their habitats (Saidi et al., 2020a). *Eimeria* infections were determined in 48% of *Gazella marica* species, 25% of which had diarrhea in Saudi Arabia (Hussein and Mohammed, 1992), and 12% in *Gazella subgutturosa* in Iraq (Saud et al., 2012). In the present study, the prevalance of *Eimeria* infection (15%) in Hatay Mountain Gazelles is close to the rate determined in Iraq and the presence of infection can be related to the herding behaviour of gazelles and frequently gathering around feeding racks and water troughs.

CONCLUSION

In conclusion, with the current study, the existence of parasites in Hatay Mountain Gazelles was comprehensively reported for the first time in Turkey. It is concluded that parasitic diseases can be prevented by monitoring proceedings including the skin and fecal examinations of the gazelles under protection.

CONFLICT OF INTEREST

The authors declared that there is no conflict of interest.

DECLARATION OF AUTHOR CONTRIBUTION

Mehmet Yaman and Muhammed Enes Altuğ made the design of the study. Mehmet Yaman made the supervision. Aykut Zerek, İpek Erdem and Fatma Nuray Şimşek made the data collection and processing. Mehmet Yaman, Meral Aydenizöz and Aykut Zerek made the analysis and discussion of the data. Aykut Zerek and Fatma Nuray Şimşek made the search of the literature, and also the writing of the article with Mehmet Yaman. Fatma Nuray Şimşek made the submission of the article and entry of subsequent revisions into the system.

DECLARATION OF ETHICS COMMITTEE

This research was approved by Animal Ethical Committee of Hatay Mustafa Kemal University (decision no: 2021/06-09).

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REFERENCES

- Altas, M. G., & Iriadam, M. (2004). The effects of parasite infections on the haematological profile in Turkish gazelle. *Indian Veterinary Journal*, 81, 868-871.
- Ashor, S. M. (2009). Prevalence of gastrointestinal parasites in red deer *Gazella subgutturosa* in Al-Masad deer protectorate in Al-Rutba city. *Anbar Journal Of Agricultural Sciences*, 7(1), 323-329.
- Baghi, M., Chamani, A., & Khajeh, F. (2016). Investigation of Gastrointestinal Parasites of *Gazella* (*Gazella subgutturosa*) in Ghamishloo National Park and Wildlife Refuge. *Journal of Earth, Environment and Health Sciences*, 2, 85. <https://doi.org/10.4103/2423-7752.199294>.
- Can, R. R. (2019). Kırıkhan ilçesinin turizm potansiyeli. *The Journal of Social Science*, 3(6), 583-599. <https://doi.org/10.30520/tjsosci.614483>.
- Carrau, T., Martínez-Carrasco, C., Garijo, M. M., Alonso, F., Vizcaíno, L. L., Herrera-Russert, J., Tizzani, P., & Ruiz de Ybáñez, R. (2021). Epidemiological approach to nematode polyparasitism occurring in a sympatric wild ruminant multi-host scenario. *Journal of Helminthology*, 95, e29. <https://doi.org/10.1017/S0022149X21000183>.
- Chochlakis, D., Ioannou, I., Papadopoulou, B., Tselentis, Y., & Psaroulaki, A. (2014). *Rhipicephalus turanicus*: From low numbers to complete establishment in Cyprus. Its possible role as a bridge-vector. *Parasites & Vectors*, 7(1), P11. <https://doi.org/10.1186/1756-3305-7-S1-P11>.
- Dantas-Torres, F., Otranto, D., Santos-Silva, M., & Vatansever, Z. (2017). *Rhipicephalus turanicus* Pomerantzev, 1940. A. Estrada-Peña, A. D. Mihalca, & T. N. Petney (Ed.), *Ticks of Europe and North Africa* içinde (ss. 329-333). Springer, Cham.
- Ergün, Y., Doğruer, G., & Sarıbay, M. K. (2010). Bir *Gazella gazella*'da (Hatay Dağ ceylanı) ultrasonografi ile gebelik tanısı. *Kafkas Üniversitesi Veteriner Fakültesi Dergisi*, 16(6), 1069-1071.
- Eslami, A., Rahbari, S., & Meydani, M. (1981). Cestodes and trematodes of wild sheep, *Ovis ammon orientalis*, and goitered gazelle, *Gazella subgutturosa*, in Iran. *Veterinary Parasitology (Netherlands)*, 8:99-101, 1981. [https://doi.org/10.1016/0304-4017\(81\)90023-6](https://doi.org/10.1016/0304-4017(81)90023-6).
- Eslami, A., Rahbari, S., & Nikbin, S. (1980). Gastro-intestinal nematodes of gazelle, *Gazella subgutturosa*, in Iran. *Veterinary Parasitology*, 7(1), 75-78. [https://doi.org/10.1016/0304-4017\(80\)90012-6](https://doi.org/10.1016/0304-4017(80)90012-6).
- Gokcen, A., Altas, M. G., Sevgili, M., Babur, C., Çelebi, B., & Kilic, S. (2007). Detecting *Toxoplasma*, *Listeria* and *Brucella* antibodies in goitered gazelles in Turkey. *Medycyna Weterynaryjna*, 63, 1064-1066.
- Gokcen, A., & Sevgili, M. (2007). Türkiye'de bir Ceylanda (*Gazella subgutturosa*) Kutanöz Miyaz Vakası. *Atatürk Üniversitesi Veteriner Bilimleri Dergisi*, 2(3), 96-98.
- Goossens, E., Dorny, P., Boomker, J., Vercammen, F., & Vercruyse, J. (2005). A 12-month survey of the gastro-intestinal helminths of antelopes, gazelles and giraffids kept at two zoos in Belgium. *Veterinary Parasitology*, 127(3-4), 303-312. <https://doi.org/10.1016/j.vetpar.2004.10.013>.
- Gürler, A. T. (2016). Ungulatların parazitleri. M. A. Taylor & R. L. Coop (Ed.), *Veteriner Parazitoloji* içinde (ss. 517-560). Medipres Matbaacılık.
- Gürler, Ş., Bozkaya, F., Özü, D., & Durmuş, M. (2015). Some morphological characteristics and neonatal weights of reintroduced gazelle (*Gazella subgutturosa*) in Turkey. *Turkish Journal of Zoology*, 39(3), 458-466. <https://doi.org/10.3906/zoo-1312-43>.

- Hadas, L., Hermon, D., Boldo, A., Arieli, G., Gafny, R., King, R., & Bar-Gal, G. K. (2015). Wild Gazelles of the Southern Levant: Genetic Profiling Defines New Conservation Priorities. *Plos One*, 10(3), e0116401. <https://doi.org/10.1371/journal.pone.0116401>.
- Hussein, H. S., & Mohammed, O. B. (1992). *Eimeria rheemi* sp. n. (Apicomplexa: Eimeriidae) from the Arabian Sand Gazelle, *Gazella subgutturosa marica* (Artiodactyla: Bovidae) in Saudi Arabia. *The Helminthological Society of Washington*, 59(2), 190-194.
- İlaslan, E. (2019). *Türkiye’de yayılış gösteren Gazella gazella (Pallas, 1766) türünün filocoğrafyası*. [Yüksek Lisans Tezi, Aksaray Üniversitesi]. <https://tez.yok.gov.tr/UlusalTezMerkezi/>
- Kankiliç, T., Özüt, D., Gürler, Ş., Kence, M., Bozkaya, F., & Kence, A. (2012). Rediscovery of a new mountain gazelle population and clarification of taxonomic status of the genus *Gazella* in Turkey using mtDNA sequencing. *Folia Zoologica*, 61(2), 129-137. <https://doi.org/10.25225/fozo.v61.i2.a6.2012>.
- Karataş, A., Filiz, H., Erciyas Yavuz, K., Özeren, S., & TOK, C. (2021). The Vertebrate Biodiversity of Turkey. İçinde M. Öztürk, V. Altay, & R. Efe (Ed.), *Biodiversity, Conservation and Sustainability in Asia* (ss. 175-274). https://doi.org/10.1007/978-3-030-59928-7_10.
- Kolapo, T. U., & Jegede, O. H. (2017). A survey of gastrointestinal parasites of captive animals at the university of Ilorin zoological garden. *Vom Journal of Veterinary Sciences*, 12(1), 17-27.
- Kurtdede, A., Aktas, M. S., Cingi, C. C., Ural, K., & Kar, S. (2007). Sarcoptic Mange in a Gazelle (*Gazella Gazella*) in Ankara, Turkey. *Journal of Applied Biological Sciences*, 1(3), 111-112.
- López, A., & Martinson, S. A. (2017). Respiratory System, Mediastinum, and Pleurae. *Pathologic Basis of Veterinary Disease*, 471-560.e1. <https://doi.org/10.1016/B978-0-323-35775-3.00009-6>.
- Mendelssohn, H., Yom-Tov, Y., & Groves, C. P. (1995). *Gazella gazella*. *Mammalian species*, 490, 1-7.
- Mir, A. Q., Dua, K., Singla, L. D., Sharma, S., & Singh, M. P. (2016). Prevalence of parasitic infection in captive wild animals in Bir Moti Bagh mini zoo (Deer Park), Patiala, Punjab. *Veterinary World*, 9(6), 540-543. <https://doi.org/10.14202/vetworld.2016.540-543>.
- Modabbernia, G., Meshgi, B., & Eslami, A. (2021). Diversity and burden of helminthiasis in wild ruminants in Iran. *Journal of Parasitic Diseases: Official Organ of the Indian Society for Parasitology*, 45(2), 394-399. <https://doi.org/10.1007/s12639-020-01314-5>.
- Mohammed, O. B. (2002). *Control of gazelle parasites at King Khalid Wildlife Research Centre (KKWRC), Saudi Arabia*. 15-18.[Paper presentation]. Proceedings of the 27th World Veterinarian Congress, Tunis.
- Mohammed, O. B., Omer, S. A., & Sandouka, M. A. (2007). The efficacy of ivermectin and levamisole against natural *Nematodirus spathiger* infection in the Arabian sand gazelle (*Gazella subgutturosa marica*) and the Arabian mountain gazelle (*Gazella gazella*) in Saudi Arabia. *Veterinary Parasitology*, 150(1-2), 170-173. <https://doi.org/10.1016/j.vetpar.2007.09.009>.
- Ortiz, J., Ruiz de Ybáñez, M. R., Garijo, M. M., Goyena, M., Espeso, G., Abáigar, T., & Cano, M. (2001). Abomasal and small intestinal nematodes from captive gazelles in Spain. *Journal of Helminthology*, 75(4), 363-365. <https://doi.org/10.1017/S0022149X01000567>.
- Ortiz, J., Ruiz de Ybáñez, R., Abaigar, T., Goyena, M., Garijo Toledo, M., Espeso, G., & Cano, M. (2006). Output of gastrointestinal nematode eggs in the feces of captive gazelles (*Gazella dama mhorr*, *Gazella cuvieri* and *Gazella dorcas neglecta*) in a semiarid region of southeastern Spain. *Journal of zoo and wildlife medicine: official publication of the American Association of Zoo Veterinarians*, 37, 249-254. <https://doi.org/10.1638/03-065.1>
- Panayotova-Pencheva, M. S., & Alexandrov, M. T. (2010). Some Pathological Features of Lungs from Domestic and Wild Ruminants with Single and Mixed Protostrongylid Infections. *Veterinary Medicine International*, 2010, 741062. <https://doi.org/10.4061/2010/741062>.
- Sağlam, Y., Kapakın, K. T., & Balkaya, İ. (2011). Bir Ceylanda (Gazelle gazelle) Hidatid Kist Olgusu. *Atatürk Üniversitesi Veteriner Bilimleri Dergisi*, 6(3), 239-243.
- Saidi, A., Mimouni, R., Hamadi, F., & Oubrou, W. (2020a). Cross-sectional study of *Eimeria* spp. Infection in three antelope species (*Addax nasomaculatus*, *Gazella dorcas* and *Oryx dammah*) maintained in the Souss-Massa National Park (Morocco). *Nature Conservation Research*, 5, 77-82. <https://doi.org/10.24189/ncr.2020.059>

- Saidi, A., Mimouni, R., Hamadi, F., & Oubrou, W. (2020b). Coprological Survey of Protostrongylid Infections in Antelopes from Souss-Massa National Park (Morocco). *Helminthologia*, 57(4), 306-313. <https://doi.org/10.2478/helm-2020-0045>.
- Saud, M. A., Oleiwi, K. I., & Omar, A. A. (2012). Prevalence of gastro-intestinal parasites in Gazelles (*Gazella subgutturosa marica*) in Al-Theabeyafarm in Iraq. *Al-Anbar Journal of Veterinary Sciences*, 5(2), 75-79.
- Sevgili, M., Şaki, C. E., & Gökçen, A. (2004). Bir ceylanda genital myiasis olgusu. *Türkiye Parazitoloji Dergisi*, 28(4), 202-204.
- Shimshony, A., Orgad, U., Baharav, D., Prudovsky, S., Yakobson, B., Moshe, B., & Dagan, D. (1986). Malignant foot-and-mouth disease in mountain gazelles. *The Veterinary record*, 119, 175-176. <https://doi.org/10.1136/vr.119.8.175>.
- Yeruham, I., Rosen, S., Hadani, A., & Braverman, Y. (1999). Arthropod parasites of Nubian ibexes (*Capra ibex nubiana*) and gazelles (*Gazella gazella*) in Israel. *Veterinary Parasitology*, 83(2), 167-173. [https://doi.org/10.1016/s0304-4017\(99\)00073-4](https://doi.org/10.1016/s0304-4017(99)00073-4).
- Yilmaz, R. (2021). The Case of Gastrointestinal Nematodiosis Forming a Nodule in a Gazelle's (*Gazella subgutturosa*) *Abomasum*. *Journal of Research in Veterinary Medicine*. 40, 73-76. <https://doi.org/10.30782/jrv.885959>.