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Identification and Distribution of Hard Ticks Species (Acari: Ixodidae) on the Northeastern Coast of Libya

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Abstract

Hard ticks (Acari: Ixodidae) are essential blood-feeding ectoparasites. Many species are medically the second-most important arthropod disease vectors for humans. Furthermore, hard ticks are the most prevalent and significant ectoparasites of domestic animals worldwide. To investigate the tick species infesting animals or the ground, seeking a host in northeastern Libya, a study of hard ticks (Acari: Ixodidae) was carried out between 2006 and 2009, which was then continued at the end of 2017–2018. Two methods were used to collect individual tick samples: direct collection from infected animals (donkeys, goats, sheep, cows, camels, and dogs) and dragging a cloth over the vegetation. The tick species were identified using morphological examinations. A total of 1991 individual ticks were identified in this study from 11 cities and regions in Libya. Overall, eleven tick species were identified: *Hyalomma* (three species), *Boophilus* (three species), *Rhipicephalus* (three species), *Amblyomma* (one species), and *Haemaphysalis* (one species). The most common tick species identified were *Hyalomma dromedarii* and *Rhipicephalus sanguineus*. Al-Marj city (meadow) had the highest number of ticks, followed by Massa city, while Ras Al-Hellal had the fewest number of ticks. This study is one of the few of its kind conducted in our country, and our findings help explain the tick species that parasitize animals. The presence of *Haemaphysalis parva* in the Al Jabal Al Akhdar region as a new species indicates a need for more comprehensive studies to inventory the local tick populations.

Keywords: Identification; Hard tick species; Northeastern Libya**.**

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1. Introduction

Hard ticks (Ixodidae) have a worldwide distribution, however they are more common in temperate regions. There are about 12 genera, but only 6 genera have medical and veterinary importance (*Ixodes, Dermacentor, Amblyomma, Heamaphysalis, Rhipicephalus,* and *Hyalomma*) which transmit diverse pathogens [1]. Ticks' blood-feeding may lead to significant economic losses because of anemia, damage to the animal's hides, decreased productivity, and weight loss. Moreover, in North Africa, ticks may act as vectors for many pathogens, such as Anaplasmosis [2], Theileriosis [3], Babesiosis [4], and Crimean-Congo hemorrhagic fever [5]. There is still a knowledge gap in identifying the most common tick species in the western Palearctic regions (Europe, the Middle East, and North Africa), particularly species in the genera *Hyalomma* and *Rhipicephalus* [6].

In Libya, thirteen species of ticks have been documented belonging to the family Ixodidae [7, 8, 9]. They are documented from farms such as *R. annulatus, R. microplus, R. decoloratus, R. sanguineus, R. evertsi, R. bursa, H. anatolicum, H. excavatum H. dromedarii, H. franchinii, H. impeltatum, H. rufipes, H. turanicum,* and *O. foleyi. Hyalomma, Rhipicephalus,* were the main genera. *H. dromedarii* was found abundant on camels, *H. impeltatum* on sheep, and *H. excavatum* on cattle. *H. dromedarii* was the most abundant tick found overall. Another study of the ectoparasite ticks of domestic animals in Libya has demonstrated that four tick species, *Hy. dromedarii, Rh. bursa, Hy. excavatum,* and *Rh. camicasi*, infest livestock in Tarhuna city [10]. Sheep have been infested with two species identified as *Hy. Marginatum* and *Rh. appendiculatus* [11]. Another study demonstrated the presence of *Rh. appendiculatus* on hedgehogs in northwestern Libya[12]. One of the species found in Libya is *R. sanguineus*, which is well known as a vector of Mediterranean spotted fever (MSF) disease, and it is generally considered to be the most common tick in the Mediterranean area [13, 14].

This study aims are to identify hard tick species infesting domestic animals in ten cities and locations along Libya's northeastern coast. Accurate specimen identification is essential for epidemiological and microbiological research on different tick species.

2. Materials and methods

2.1. Sampling locations and study design

The sampling locations included the city of Benghazi and its suburb, Nawgia (located 25 km south of Benghazi). The study was also conducted in 7 cities in the Al Jabal Al Akhdar region (green mountain): Al-Marj, Massa, Rasa Helal, Soussa, Al-Bayda, Shhaat, and Darana. Furthermore, the study extended to Wadi Alkouf (a valley located between Al-Bayda and Massa) and Tanguma (located 19 km west of al-Marj). The mountainous area is generally rocky, stony, and frequently intercepted by wadis (valleys). The average rainfall in Jabal Al Akhdar ranges between 250 and 600 mm; the soil is terra-rossa, or heavy clay. The landscape shifts between soft and smooth mountain landscapes [15]. The mountain extends along the Mediterranean coast for about 100 miles (160 km) in an east-northerly direction between the cities of al-Marj and Darnah, rising sharply in two steps, the first reaching 985 feet (300 m) and the second about 1,800 feet (550 m). The climate is

Mediterranean, with warm summers and mild winters. Rainfall is scanty. The weather is cooler in the highlands, and frosts occur at maximum elevations [15].

The collection of ticks was conducted over four periods. We started in April 2006, which was referred to as the first round in seven cities. Round 2 was from April to August 2007 in the same cities. Round 3 was from March to August 2008 in nine cities. The last fourth round was in December 2017 and from February to April 2018 at around five locations.

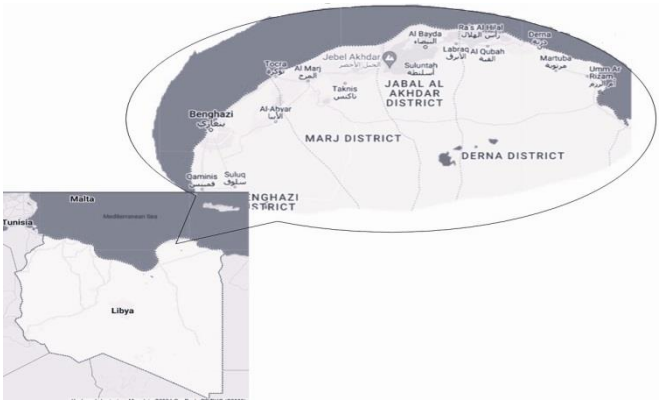


Figure1: The locations in the eastern part of Libya where ticks are collected [29]

2.2. *Ticks' collection and identification*

Two methods were used to collect ticks: I- For ground collection, a white flannel fabric measuring 1 m^2 of cotton was attached to a wooden pole using cords. The fabric was horizontally dragged over the ground vegetation, and at intervals of 10 meters, it was inspected. Ticks attached to the fabric were counted and collected during the inspection [16]. II- Ticks were collected from domestic animals such as horses, cattle, sheep, goats, and dogs; one to ten ticks were collected from each infested animal. The ticks were then removed from their hosts or the fabric using tweezers and placed in small tubes with 70% ethanol at room temperature. Climatic data, including temperature and relative humidity, were recorded during each collection.

Tick identification was conducted at Uppsala University, Sweden, by the researchers under the supervision of Thomas Jeanson and Julio Grandi. The identification process involved microscopic observation (using a microscope with a magnification of 610–50), and the ticks were categorized into family, genus, and species based on established taxonomic keys and morphometric tables available for tick identification [17, 18, 19, 20].

3. Results

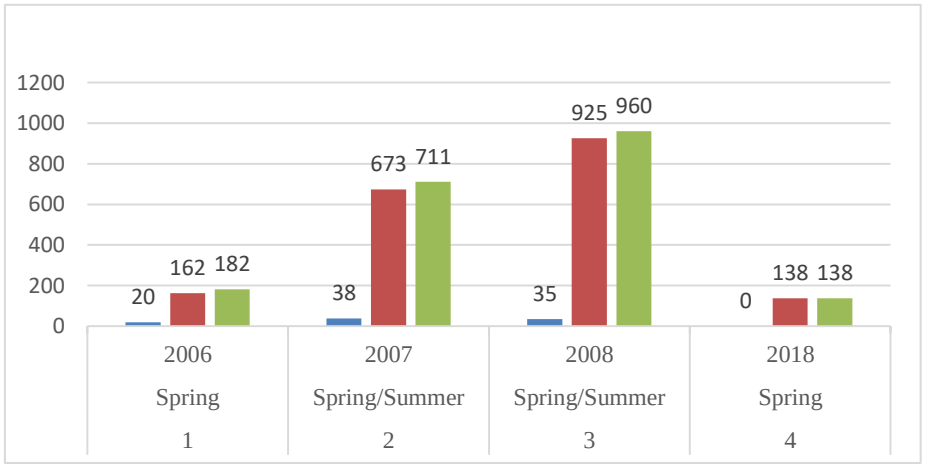
A total of 1991 ticks randomly collected from domestic animals and on the ground—eleven species belonging to the order Ixodidae—were identified and are presented in Table 1. The humidity was between 32% and 75%, and the temperature was between 20.5 and 35 °C. The tick abundance and number of tick collections over the four rounds are shown in Table 2 and Figure 2. The distributions of tick collections across different cities are shown in Figure 3. It is apparent that Al-Marj, characterized as a meadow, exhibited the highest tick abundance , followed by Massa City. whereas the Ras Al-Hellal area had the lowest density of ticks.

Table1: Identification of the collected ticks and their associated host animal/area

Infested animals/ground	Tick species
Camel	*Hy. Marginatum, Hy.dromedarii*
Goat	*B. annulatus, Amblyomma spp.*
Cow	*B. decoloratus, B. microplus*
Dog	*Rh. Sanguineus, Rh. Turanicus, and Rh. Spp,*
Donkey	*B. decoloratus*
Horses	*B. microplus,*
Sheep	*Rh. Sanguineus, Rh. Turanicus, B. annulatus, and Hy. Franehini, Haemaphysalis parva*
Ground	*Hy. Marginatum, Hy.dromedarii (nearby the water)*

Table 2: Tick abundance and number of tick collection over the four periods

No. of rounds	Date		No. of ticks		Total	Tick abundance %
	Season	Year	Ground	Host		
1	Summer	2006	20	162	182	9.14 %
2	Spring/Summer	2007	38	673	711	35.71 %
3	Spring/Summer	2008	35	925	960	48.21 %
4	Spring	2017-2018	0	138	138	6.93%
			93	1898	1991	



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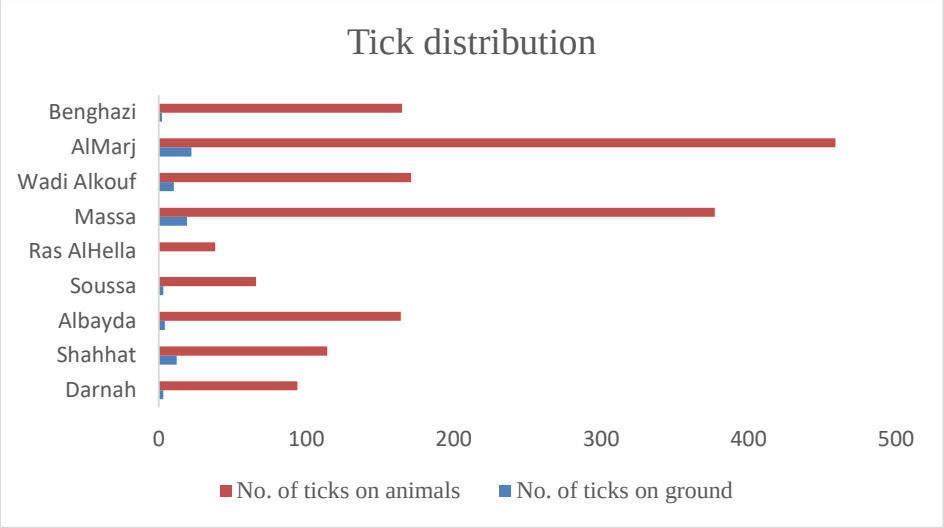

Figure 3: The distribution of ticks in the cities of northeastern Libya

4. Discussion

Adult ticks were collected from eleven cities and regions in both ground-dwelling and domestic animals and Eleven species were identified. Among these species, ten had been previously identified in other studies conducted in Libya. These findings account for a significant portion of the thirteen tick species known in the region, as documented by [7, 8, 9].

The brown dog tick (*Rh. sanguineus*) and *H. dromedarii* were the most prevalent in the region. *Rh. sanguineus*, known as a parasite of dogs, has the ability to occasionally infect humans and other hosts, making it the most widespread tick species worldwide. However, it should be noted that some ticks currently identified as *Rh. sanguineus* might actually belong to closely related species, such as *Rh. turanicus*. Additionally, *Rh. sanguineus* species are known to transmit various disease-causing agents, including *Coxiella burnetii*, *Ehrlichia canis*, *Rickettsia conorii* and *Rickettsia rickettsia* [21]. A recent study conducted in Al bayda (in northeastern Libya) provided compelling evidence supporting the association between ticks and the infection of individuals with the spotted fever group Rickettsiae. The study included patients who exhibited strong epidemiological and clinical characteristics consistent with spotted fever. Notably, all the patients resided in areas known to be infested with ticks, reinforcing the link between tick presence and the transmission of Rickettsiae [14]. Unfortunately, they did not provide taxonomic identification of the tick genera or species from which the bacteria were isolated. However, the study relied on the classification established by [9], which refers to ticks collected from farms in Al-Bayda city. The prevailing tick species in that area, as defined, is the brown dog tick (*Rh.sanguineus*) [9].

Whereas *H. dromedarii* is the most important tick species infesting camels in the Middle East and North Africa; all *H. dromedarii* individuals included in this study were collected from camels. This tick species can transmit viruses such as the Crimean–Congo hemorrhagic fever virus [23], bacterial diseases such as Q fever (*C. burnetii*) , protozoan diseases, including theileriosis in camels (*Theileria camelensis*) and in cattle, (*T. annulata*) , and spotted fever rickettsia (24].

H. Marginatum was collected from sheep, which is consistent with the findings of Rashed and his colleagues (2010) [11]. Boophilus species , *B. annulatus, B. decoloratus* and *B. microplus* were collected from different animals such as gout, cows, horses, and sheep, and this finding has been sporadically described in the literature [7, 8].

However, there was one species that had not been mentioned in any prior research in Libya: the Mediterranean ear tick, *Hyalomma parva*. This tick species is typically found in the Mediterranean mountains and forests, thriving at high altitudes with elevated humidity levels. It is widespread in Mediterranean countries such as Turkey, Italy, and Greece, where it infects livestock and coexists with human populations [25, 26, 27]). Further research by our team revealed the presence of *H. parva* for the first time in the Shahat region of Libya [28]. The Shahat region is characterized by mountainous terrain and a climate similar to other areas where this tick species has been reported, including Turkey and Greece, as mentioned above. The parasitism of *H. parva* occurs during autumn, winter, and spring, with a peak in October and November [27]. During a study conducted in Al-Bayda city, a significant discovery was made as the species *Rh. camicasi* was observed for the first time in Libya [9]. However, in the sudy no specimens of this particular species were obtained. Regarding the population density of ticks, the study showed that Al-Marj City exhibited the highest tick abundance compared to other cities, and Massa City followed with a substantial tick presence as well. In contrast, the Ras Al-Helal area has the lowest density of ticks. There are various factors contributing to this situation, one of which is the influx of herdsmen from semi-desert regions, such as Ajdabiya, who travel to Al-Marj city during the spring and summer seasons for livestock grazing. These herdsmen bring a significant number of animals that serve as hosts for ticks, resulting in an increased tick population in the area. Another factor is that farmers in the Al-Marj region may not employ regular pesticide usage to control tick populations, unlike their counterparts in other cities. This lack of proactive tick management measures has likely contributed to the higher tick abundance observed in Al-Marj compared to other areas. Overall tick infestations seen during the study often showed a low population density, with one species of tick infesting the host most of the time. It was found that more than one tick species rarely coexists on the same host.

5. Conclusion

Over a five-year study, we identified and compared the infestation rates of hard tick species in northeastern Libya. Eleven tick species were found to infest domestic animals, with *Rh. sanguineus* and *Hy. dromedarii* were the most predominant species in the region. The study found that Al-Marj city exhibited the highest prevalence of ticks whereas Ras Al-Hellal had the lowest prevalence of ticks among the areas examined.

6. Constraints \limitations of the study

Due to financial constraints, the study was limited to ten cities and locations in northeastern Libya, with a primary focus on ticks that affect domestic animals. Consequently, this may have led to the exclusion of some tick species in other regions and species affecting wildlife, affecting the generalizability of the results. Additionally, the study relied on morphological characteristics for tick identification, as genetic analysis of evolutionary relationships between tick species was unfeasible.

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7. Conflicts of Interest

The authors have no competing interests to declare.

References

[1] Levin, M. L. *Medical Entomology for Students, 5th Edition*. Cambridge University Press, New York, New York, USA, 2014, pp.224-237.

[2] Said, M.B., Belkahia, H. & Messadi, L., "Anaplasma spp. in North Africa: a review on molecular epidemiology, associated risk factors and genetic characteristics," *Ticks and Tick-Borne Diseases*, vol. 9, pp. 543–555, 2018.

[3] Aouadi, A., Leulmi, H., Boucheikhchoukh, M., Benakhla, A., Raoult, D. & Parola, P., "Molecular evidence of tick-borne hemoprotozoan-parasites (Theileria ovis and Babesia ovis) and bacteria in ticks and blood from small ruminants in northern Algeria," *Comparative Immunology, Microbiology and Infectious Diseases*, vol. 50, pp. 34–39, 2017.

[4] Walker, A., Bouattour, A., Camicas, J.L., et al., *Ticks of Domestic Animals in Africa: A Guide to Identification of Species*, Edinburgh, Scotland, UK: Bioscience Reports, 2003.

[5] Okely, M., Anan, R., Gad-Allah, S. & Samy, A.M., "Mapping the environmental suitability of etiological agent and tick vectors of Crimean-Congo hemorrhagic fever," *Acta Tropica*, vol. 203, p. 105319, 2020.

[6] Estrada-Peña A, Mihalca D, Petney T., *Ticks of Europe and North Africa : a Guide to Species Identification*, Cham: Springer, 2017.

[7] Hoogstraal, H., & Kaiser, M. N., "Observations on ticks (Ixodoidea) of Libya," *Annals of the Entomological Society of America*, vol. 53, no. 4, pp. 445-457, 1960.

[8] Gabaj, M.M., Awan, M.A.Q. and Beesley, W.N., "A survey of ticks on farm animals in Libya," *Ann. Trop. Med. Parasitol*., vol. 86, no. 5, pp. 543-548, 1992.

[9] Hador, A.B., A survey on ticks in some surrounding farms of Al-Baida, Al-Jabel Al-Akhdar, Libya, M.Sc thesis, Omar AL-Mukhtar University, Al-Baida, Libya, 2015.

[10] Abdulsalam, A. M., Saadawi, W. K., Kharwat, H. I., & Shaibi, T., "Species diversity of ticks (Acari: Ixodidae) in Tarhuna, Libya," *Open Veterinary Journal*, vol. 12, no. 3, pp. 370-374, 2022.

[11] Rashed, A., EL Naas, A. and EL Maghrbi, A.A., "A study on the ectoparasites of sheep and goat in Libya," *in The 7th International Conference on the Future Horizone of Environmental Development in Arab region and Facing the Challenges*, pp. 17-20, Ghardaga, Egypt, 2010.

[12] Hosni, M. N., & El Maghrbi, A. A., "Ectoparasites infestation of free-ranging hedgehog (Etelerix algirus) in north western Libya," *Open Veterinary Journal*, vol. 4, no. 1, pp. 12-15, 2014.

[13] Colomba, C., Saporito, L., Polara, V. F., Rubino, R., & Titone, L., "Mediterranean spotted fever: clinical and laboratory characteristics of 415 Sicilian children," *BMC infectious diseases*, vol. 6, no. 1, pp. 1-5, 2006.

[14] Mohamed W. S. , Mohammed A. A., Ekhnafer A. M., Ali M.S., "The Relationship between Spotted Fever Group Rickettsiae and Ticks in Northeast of Libya," Saudi J Biomed Res, vol. 6, no. 2, pp. 18-22, 2021.

[15] Flora of Libya. "Environmental Systems in Libya,":https://www.floraoflibya.services.ly/display.php?selected=Vegetation. July 2019 [Nov.15. 2019].

[16] Mejlon, H. A., & Jaenson, T. G., "Seasonal prevalence of Borrelia burgdorferi in Ixodes ricinus in different vegetation types in Sweden," *Scandinavian journal of infectious diseases*, vol. 25, no. 4, pp. 449-456, 1993.

[17] Hoogstraal, H and Kaiser, M. N., "The ticks (Ixodoidea) of Egypt: A brief review and keys," *The Journal of the Egyptian public health association*, vol. 3, pp. 52-83, 1958.

[18] Hoogstraal, H., Wassef, H. Y., and Buttiker, W., "Ticks (Acarina) of Saudi Arabia Fam. Argasidae, Ixodidae," *Fauna of Saudi Arabia*, vol. 3, pp. 25-110, 1981.

[19] Manilla, G., *Acari Ixodidae*, Calderini, 1998, pp. 1-280.

[20] Estrada-Pena, A., D'Amico, G., Palomar, A.M. et al., "A comparative test of ixodid tick identification by a network of European researchers," *Ticks and Tick-borne Diseases*, vol. 8, pp. 540–546, 2017.

[21] Perveen, N., Bin Muzaffar, S., & Al-Deeb, M. A., "Population dynamics of Hyalomma dromedarii on camels in the United Arab Emirates," *Insects*, vol. 11, no. 5, p. 320, 2020.

[22] Lange, J. V., El Tick, D. T. F. B. D., "Rhipicephalus sanguineus (Latreille, 1806)(Arachnida: Acari: Ixodidae)," *Vet Parasitol*, vol. 152, no. 3-4, pp. 173-85, 2008.

[23] Rodriguez, L.L.; Maupin, G.; Ksiazek, T.G.; Rollin, P.E.; Khan, A.L.S.; Schwarz, T.E.; Lofts, R.S.; Smith, J.F.; Noor, A.M.; Peters, C.J.; et al., "Molecular investigation of a multisource outbreak of Crimean Congo hemorrhagic fever in the United Arab Emirates," *Am. J. Trop. Med. Hyg*., vol. 57, pp. 512–518, 1997.

[24] Dessouky, A. G., Manor, E., Merdan, A. I., & Azad, A. F., "Spotted fever rickettsiae in ticks from the northern Sinai Governate, Egypt," *The American journal of tropical medicine and hygiene*, vol. 46, no. 5, pp. 546-551, 1992.

[25] Bursali A, Tekin S, Keskin A, Ekici M, Dundar E, "Species diversity of ixodid ticks feeding on humans in Amasya, Turkey: seasonal abundance and presence of Crimean-Congo hemorrhagic fever virus," *J Med Entomol*, vol. 48, no. 1, pp. 85–93, 2011.

[26] Papa A, Kontana A, Tsioka K, Saratsis A, Sotiraki S, "Novel phlebovirus detected in Haemaphysalis parva ticks in a Greek island," *Ticks Tick-borne Dis*, vol. 8, no. 1, pp. 157–160, 2017.

[27] Vatansever, Z., "Haemaphysalis parva (Neumann, 1897)(Figs. 100–102)," Ticks of Europe and North Africa: A guide to species identification, pp. 259-263, 2017.

[28] Garboui, S. S., Elmhalli, F. H., and Grandi, G., "First Report of The Ectoparasite Ticks Haemaphysalis Parva (Neumann, 1897) Collected From Domestic Animals In Libya," *Al-Mukhtar Journal of Sciences* (In press), 2018.

[29] Google Maps " Libya," : https://maps.app.goo.gl/MBqqAw4UD91cHwwD7. Feb 11, 2024 [Aug.10.2023].