IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 12, Issue 1 Ser. II (January 2019), PP 52-56
www.iosrjournals.org

Spatial Distribution of Rabies in Wild Animals in East and Southeast Anatolia Regions of Turkey, 2010-2015

Aynur Simsek[1], Hasan Icen[1], Metin Gurcay[2], Akin Kochan[1], Ozgur Yasar Celik[3*]

[1]*Faculty of Veterinary Medicine, Department of Internal Medicine, University of Dicle, Diyarbakır, Turkey*
[2]*Faculty of Veterinary Medicine, Department of Virology, University of Bingol, Bingol, Turkey*
[3]*Faculty of Veterinary Medicine, Department of Internal Medicine, University of Siirt, Siirt, Turkey*
Corresponding Author: Aynur Simsek

Abstract: *Rabies is a viral disease with a high mortality rate caused by a neurotropic virus that is capable of infecting all mammals. In many developed countries, the primary vectors for the rabies virus are the wild animals. In Turkey, on the other hand, the disease is mostly dog-mediated, and it has been reported that more than 70% of the rabies cases in Turkey were caused by dogs. In this study, the aim was to retrospectively evaluate the epidemiology of the rabies cases encountered in the Eastern and Southeastern Anatolia regions between 2010 and 2015 based on the virus isolations and laboratory diagnoses. The animal material of the study consists of 40 wildlife animals (wolves, foxes, weasels, badgers) diagnosed with rabies brought to Elazığ Veterinary Control Institute from the Eastern and Southeastern Anatolia regions of Turkey between 2010 and 2015. The distribution of the cases for these regions in a provincial basis was as follows: Elazığ 15, Malatya 11, Diyarbakır 5, Muş 3, Van 2, Bingöl 2, Tunceli 1, and Bitlis 1, for a total of 40 cases. Wildlife rabies in many European countries has been brought under control through the use of oral vaccinations. The results of our study indicate that the wildlife rabies can be brought under control in Turkey as well through motivation and support of relevant authorities and other stakeholders, and oral vaccination campaigns performed on wildlife for extended periods of time. Meanwhile, it would also be possible to eliminate rabies in urban areas through control of stray dogs and conducting campaigns for vaccination of all dogs.*

Keywords: *Wild rabies, East Anatolia, Southeast Anatolia, Turkey*

Date of Submission: 06-01-2019 Date of acceptance: 21-01-2019

I. Introduction

Rabies is a viral disease with a high mortality rate caused by a neurotropic virus that is capable of infecting all mammals [1]. It is caused by a negative strand RNA-virus belonging to the genus *Lyssavirus*, family *Rhabdoviridae* of the order *Mononegavirales* [2]**.** It is reported that the disease is encountered in all continents except Africa [3], and 55.000 people a day every year because of the disease [4, 5]**.**

The virus enters the body as the rabiate animal bites the organism and moves through the neurons towards the central nervous system with a preference for the cerebrum and the cerebellum (centripedal involvement), and from here they move through the peripheral nerves to infect the salivary glands and other end organs [6, 7]. The diagnosis is performed through clinical inspections, and by applying the Reverse Transcriptase-Polymerase Chance Reaction (RT-PCR) method on samples that demonstrate postmortem autolysis and decay, demonstrating the presence of Negri bodies. On the freshly collected samples, however, another method of diagnosis is performed by applying a direct fluorescence antibody technique (direct FAT) to observe the Negri bodies. When the Negri bodies can't be observed, virus isolation methods are utilized [8, 9]. Although the rabies-related mortality rate is low due to the advanced medical technology of modern times, the virus nevertheless causes deaths of thousands in numerous regions such as Africa and India [10].

In many developed countries, the primary vectors for the rabies virus are the wild animals [11]. In Turkey, on the other hand, the disease is mostly dog-mediated [12, 13], and it has been reported that more than 70% of the rabies cases in Turkey were caused by dogs [12, 14].

Vaccinations are one of the most effective methods against infectious diseases. The most prominent examples of vaccination of wildlife populations are the large-scale oral vaccination programs that reduced the fox rabies in Western Europe and reduced the frequency of the disease in Eastern Europe [15, 16]. The vaccination programs are reported to have eliminated the dog-mediated rabies disease in most of America, and the whole of Europe [15].

In this study, the aim was to retrospectively evaluate the epidemiology of the rabies cases encountered in the Eastern and Southeastern Anatolia regions between 2010 and 2015 based on the virus isolations and laboratory diagnoses.

II. Materials and Methods

Study area

The study area consists of the provinces of Bingöl, Bitlis, Diyarbakır, Elazığ, Malatya, Muş, Tunceli, and Van, which are located in the Eastern and Southeastern Anatolia regions (Figure 1).

Animal material

The animal material of the study consists of 40 wildlife animals (wolves, foxes, weasels, badgers) diagnosed with rabies brought to Elazığ Veterinary Control Institute from the Eastern and Southeastern Anatolia regions of Turkey between 2010 and 2015 (Table 1).

Direct fluorescence antibody technique (Direct FAT)

The direct FAT method which is used as a means of diagnosis for rabies disease was performed as specified by Dean *et al.* (1974)**.** In this method, the disease is detected when the viral antigens in the preparations obtained from brain samples of rabiate or rabies-suspected animals attach to the fluorescein isothiocyanate (FITC) mm monoclonal antibody conjugates (Fujirebio Diagn. Comp. Millipore Corp. USA) [9]**.**

Virus Isolation

The virus isolation procedure in cases where the sample was negative according to Direct FAT was performed as suggested by OIE (2009). The brain sample or spinal fluid obtained from rabiate or rabies-suspected animal was inoculated into the brains of mice. The mice were then observed for 21 days after the inoculation. The brains of mice which died during this period were then inspected with the Direct FAT method.

III. Results

Since some of the samples obtained in summer months were putrefied, the RT-PCR test was used to perform diagnosis on them. All of the samples which weren't putrefied were tested with Direct FAT test, and those returned negative from the Direct FAT test were inspected with the virus isolation test. Based on the test results, 40 animals were diagnosed with rabies, of which 13 were wolves, while 23 were foxes, 2 were weasels, and 2 were badgers. The distribution of animals diagnosed with rabies based on animal species, years, and provinces are given in Table 1. An inspection of this table reveals that the highest rate of diagnosis was for the year 2013, while the lowest was for 2010. Between the years 2010 and 2015, the province of Elazığ had the most number of rabies cases while Tunceli had the lowest. From highest to lowest, the animal species that were infected with rabies during this period was as follows: foxes, wolves, weasels, and badgers.

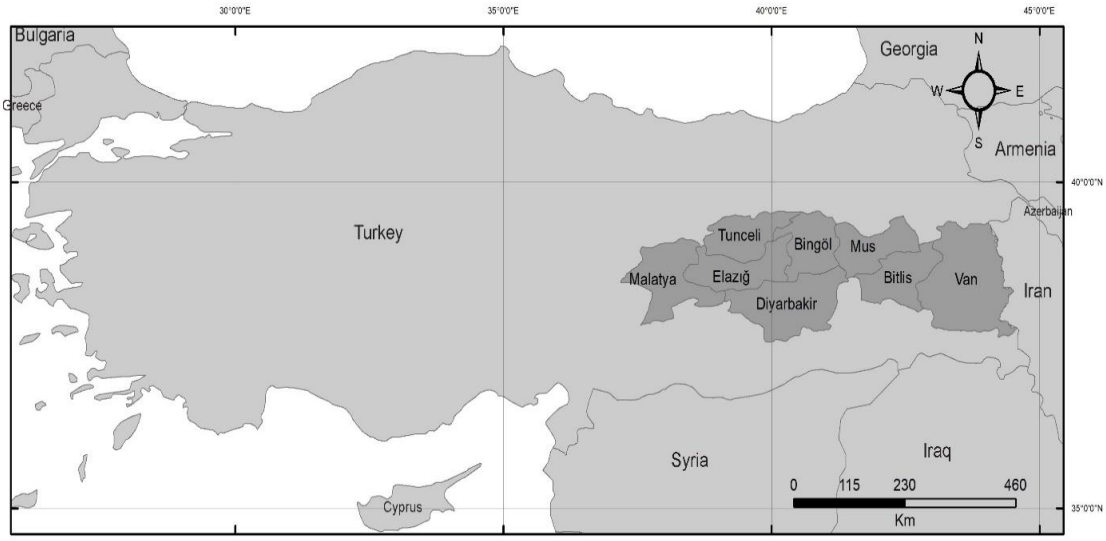

Figure1. Map of the Spatial Distribution of Wild Rabies in East and Southeast Anatolia regions in Turkey

Table1. Distribution of Wild Rabies in East and Southeast Anatolia in Turkey

Province	Species	2010	2011	2012	2013	2014	2015	Overall	
Bingöl	Wolf	0	1	0	1	0	0	2	2
	Fox	0	0	0	0	0	0	0	
	Weasel	0	0	0	0	0	0	0	
	Badger	0	0	0	0	0	0	0	
Bitlis	Wolf	0	0	0	0	0	0	0	1
	Fox	0	0	0	0	0	0	0	
	Weasel	0	0	0	0	0	0	0	
	Badger	0	0	0	0	0	1	1	
Diyarbakır	Wolf	0	0	0	0	0	0	0	5
	Fox	0	2	0	2	1	0	5	
	Weasel	0	0	0	0	0	0	0	
	Badger	0	0	0	0	0	0	0	
Elâzığ	Wolf	0	1	0	0	0	1	2	15
	Fox	0	1	3	2	6	0	12	
	Weasel	0	0	0	1	0	0	1	
	Badger	0	0	0	0	0	0	0	
Malatya	Wolf	0	0	0	3	0	0	3	11
	Fox	0	1	3	1	1	0	6	
	Weasel	0	0	0	0	0	1	1	
	Badger	0	0	0	1	0	0	1	
Muş	Wolf	0	1	0	1	1	0	3	3
	Fox	0	0	0	0	0	0	0	
	Weasel	0	0	0	0	0	0	0	
	Badger	0	0	0	0	0	0	0	
Tunceli	Wolf	1	0	0	0	0	0	1	1
	Fox	0	0	0	0	0	0	0	
	Weasel	0	0	0	0	0	0	0	
	Badger	0	0	0	0	0	0	0	
Van	Wolf	0	0	1	0	1	0	2	2
	Fox	0	0	0	0	0	0	0	
	Weasel	0	0	0	0	0	0	0	
	Badger	0	0	0	0	0	0	0	
Overall	Wolf	1	3	1	5	2	1	13	40
	Fox	0	4	6	5	8	0	23	
	Weasel	0	0	0	1	0	1	2	
	Badger	0	0	0	1	0	1	2	
		1	**7**	**7**	**12**	**10**	**3**	**40**	

IV. Discussion

In America, 92.6% of the rabies cases encountered in 2014 were reported to have a wildlife origin, and 30.2% of these involved raccoons, while 29.1 involved bats, 26.3% skunks, and 4.1% foxes [18]**.** While in Europe the dogs were the main sources for the rabies cases a couple centuries ago, the mass vaccinations, limitation of animal movements, and using masks on dogs resulted in the elimination of dog-mediated rabies cases [15]**.** Today, most of the rabies cases encountered in Europe are reported to be of sylvatic origins where the main reservoirs for the disease are the red foxes *(Vulpes vulpes)* [2, 7]**.** In many countries, wildlife rabiates are becoming a significant threat to pets and humans. It is reported that rabies enters urban life mostly through dense interactions between stray dogs and wildlife animals [19]**.**

It is also reported that Turkey is the only country in which dog-mediated urban rabies cases are encountered [2]**,** and more than 70% of the rabies cases reported in Turkey were caused by dogs, which is followed by cats and ruminants [12, 13, 20]**.** The Aegean and Marmara regions are particularly reported for the rabies case frequency [6, 7]**.**

Even though most rabies cases in Turkey are dog-mediated, wildlife rabies cases are also reported. Between 1989 and 2001, 1 wolf in Samsun, 3 foxes in Manisa, 2 foxes in İzmir, and 1 fox in Erzurum were reportedly diagnosed with rabies, for a total of 7 wild animals [21]**.**

Between 1999 and 2003, 22 in Izmir, 2 in Manisa, 6 in Muğla and 21 foxes rabies in Aydın were reported [12]. Of the 2856 rabies cases in Turkey between 1990-2000, 1.6% were reportedly of wildlife animals, the fox-mediated cases had an increasing trend in Aegean region, and of the 174 foxes inspected in this period, 165 (95%) were positive [13]**.**

In a study conducted by Gürçay *et al*. (2010) spanning between 2004 and 2009 in East and Southeast Anatolia regions of Turkey, a total of 22 animals were diagnosed with rabies, of which 13 were foxes, 8 were wolves, and 1 was a weasel. The same study also sorted the rabies cases based on the cities they were encountered in from the highest to lowest, and the results were as follows: Diyarbakır (75/94-9.78%), Elazığ (41/87-%47.12), Malatya (25/49-%51.02), Mardin (23/34-%67.64), Van (15/23-%65.21), Tunceli (10/17-

%58.82), Bingöl (9/15-%60), Hakkâri (9/17-%52.94), Muş (9/18-%50), Şırnak (6/9-%66.66), Bitlis (5/8-%62.50), Batman (2/6-%33.33), and Siirt (2/7-%28.57).

In studies conducted between 2008 and 2011 in all 7 regions of Turkey, 135 wild boars were reported rabies positive [22]**.** East Anatoli region is neighbored by Iran, Azerbaijan, Armenia, and Georgia to the east, and by Iraq to the southeast. The prevalence for rabies encountered in Iran between 1999 and 2009 for dogs, cats, wolves, foxes, jackals, and other wild animals are reported as 80.5%, 14.8%, 0.2%, 0.16% and 1.5%, respectively [23]**.** According to laboratory data from Iran between 2010 and 2012, the brains of 293 dogs, 47 wolves, 34 foxes, 16 jackals, and 5 cats were diagnosed with rabies during an inspection in laboratories [24]**.**
Of the 61 rabies cases encountered in Azerbaijan in 2005 and 2006, 8 (13%) were reported as the wild animal origin [25] A total of 1759 animal rabies cases were reported in Georgia between 2000-2017 [26].

In this study, the rabies cases detected in East and Southeast Anatolia regions of Turkey between 2010 and 2015 in a provincial basis was as follows: Elazığ 15, Malatya 11, Diyarbakır 5, Muş 3, Van 2, Bingöl 2, Tunceli 1, and Bitlis 1, for a total of 40 cases. The highest rabies case amount was detected in Elazığ, which might be due to the fact that the Veterinary Control Institute is located here, and the samples of rabies-suspected animals were easier to send to a laboratory in this province.

The present study also reports the foxes as the species in which rabies was encountered the most. This situation may be explained by the fact that the ideal locations for the feeding of foxes are within cities and their vicinity, and in and around the motorways.

V. Conclusion

Wildlife rabies in many European countries has been brought under control through the use of oral vaccinations. The results of our study indicate that the wildlife rabies can be brought under control in Turkey as well through motivation and support of relevant authorities and other stakeholders, and oral vaccination campaigns performed on wildlife for extended periods of time. Meanwhile, it would also be possible to eliminate rabies in urban areas through control of stray dogs and conducting campaigns for vaccination of all dogs.

Conflicts of interest
There are no conflicts of interest.

References

[1]. WHO. (1996). Laboratory Techniques in Rabies (Fourth ed.): Geneva, Switzerland.
[2]. Freuling, C., Klöss, D., Schröder, R., Kliemt, A., and Müller, T. The WHO Rabies Bulletin Europe: a key source of information on rabies and a pivotal tool for surveillance and epidemiology. Rev Sci Tech. 2012; 31 (3), 799-807.
[3]. Bannazadeh Baghi, H., Alinezhad, F., Kuzmin, I., and Rupprecht, C. A Perspective on Rabies in the Middle East—Beyond Neglect. Veterinary sciences. 2018; 5 (3), 67.
[4]. Thiptara, A., Atwill, E.R., Kongkaew, W., and Chomel, B.B. Epidemiologic trends of rabies in domestic animals in southern Thailand, 1994–2008. The American journal of tropical medicine and hygiene. 2011; 85 (1), 138-145.
[5]. WHO. (2009). Human and Animal Rabies. Retrieved from http://www.who.int/rabies/en
[6]. Batmaz, H. (2013). Kuduz Koyun ve Keçilerin İç Hastalıkları: Nobel Tıp Kitap Evleri.
[7]. Gül, Y. (2006). Kuduz. In Y. Gül (Ed.), Geviş getirenlerin hayvanların iç hastalıkları (sığır, koyun-keçi): Medipres matbaacılık ltd.Şti.
[8]. Gürçay, M., Turan, T., Özkaraca, M., and Irehan, B. Epidemiological Survey of Animal Rabies in Eastern and Southeastern Anatolia Regions, Turkey. FÜ Sağ. Bil Vet Derg. 2010; 25, 61-66.
[9]. OIE. (2009). Terrestrial Manual Chapter. Retrieved from https://goo.gl/wbH6Sa
[10]. Liu, H. (2013). Spatial Spread of Rabies in Wildlife. (PhD), Arizona State University, USD.
[11]. Brown, L., Rosatte, R., Fehlner-Gardiner, C., Bachmann, P., Ellison, J., Jackson, F., Taylor, J., Davies, C., and Donovan, D. Oral vaccination and protection of red foxes (Vulpes vulpes) against rabies using ONRAB®, an adenovirus-rabies recombinant vaccine. Vaccine. 2014; 32 (8), 984-989.
[12]. Johnson, N., Un, H., Vos, A., Aylan, O., and Fooks, A. Wildlife rabies in Western Turkey: the spread of rabies through the western provinces of Turkey. Epidemiology and infection. 2006; 134 (02), 369-375.
[13]. Vos, A., Freuling, C., Eskiizmirliler, S., Ün, H., Aylan, O., Johnson, N., Gürbüz, S., Müller, W., Akkoca, N., Müller, T., Fooks, A., and Askaroglu, H. Rabies in Foxes, Aegean Region, Turkey. Emerging Infectious Diseases. 2009; 15 (10), 1620-1622.
[14]. Aylan, O., Yoruk, I., and Un, H. Rabies in Turkey. J Etlik Vet. 1998; 9, 3-8.
[15]. Freuling, C., Hampson, K., Selhorst, T., Schröder, R., Meslin, F., Mettenleiter, T., and Müller, T. The elimination of fox rabies from Europe: determinants of success and lessons for the future. Phil. Trans. R. Soc. B. 2013; 368 (1623).
[16]. Vitasek, J. A review of rabies elimination in Europe. Vet. Med. – Czech. 2004; 49, 171–185.
[17]. Dean, D., and Ableseth, M. (1974). Laboratory techniques in rabies. Geneva: WHO.
[18]. CDC. (2016). Retrieved from http://www.cdc.gov
[19]. Moges, N. Epidemiology, prevention and control methods of rabies in domestic animals. Eur. J. Biol. Sci. 2015; 7 (2), 85-90.
[20]. Aylan, o., El-Sayed, A.F.M., Farahtaj, F., Janani, A.R., Lugach, O., Tarkhan-Mouravi, O., Usluer, G., Vodopija, R., Vranjes, N., and Tordo, N. Report of the first meeting of the middle East and eastern europe rabies expert bureau, istanbul, Turkey. Advances in preventive medicine. 2011.
[21]. Johnson, N., Black, C., Smith, J., Un, H., McElhinney, L., Aylan, O., and Fooks, A. Rabies emergence among foxes in Turkey. Journal of Wildlife Diseases. 2003; 39 (2), 262-270.

[22]. Vos, A., Ün, H., Hampson, K., Balogh, K., Aylan, O., Freuling, C., Müller, T., Fooks, A., and Johnson, N. Bovine rabies in Turkey: patterns of infection and implications for costs and control. Epidemiology and infection. 2014; 142 (09), 1925-1933.
[23]. Gholami, A., Massoudi, S., Moghaddam, M., Marashi, M., Marashi, M., Bashar, R., Fayaz, A., Fazeli, M., Farahtaj, F., Howaizi, N., and SM, R. The Role of the Gray Wolf in Rabies Transmission in Iran and Preliminary Assessment of an Oral Rabies Vaccine in this Animal. Journal of Medical Microbiology and Infectious Diseases. 2017; 5 (3), 56-61.
[24]. Gholami, A., Fayaz, A., and Farahtaj, F. Rabies in Iran: past, present and future. Journal of Medical Microbiology and Infectious Diseases. 2014; 2 (1), 1-10.
[25]. Safi, N., Asadov, K., Zeynalova, S.K., Gasanov, E., and Javadov, N. The prevalence of rabies cases in the territory of Azerbaijan, January 2015-June 2016. Online journal of public health informatics. 2017; 9 (1).
[26]. Imnadze, P. (2018, 23-25 April). Rabies Surveillance in Georgia. Paper presented at the 4th MEEREB Meeting, Annecy, France.

Aynur Simsek. " Spatial Distribution of Rabies in Wild Animals in East and Southeast Anatolia Regions of Turkey, 2010-2015." IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS) 12.1 (2019): PP- 52-56.