

Monitoring Red Deer and Roe Deer Population Density in Yedigoller-Yesiloz Wildlife Reserves in Turkey

Vedat Beskardes

Game and Wildlife Program, Vocational School of Forestry, Faculty of Forestry,
Istanbul University, 34473 Sariyer, Istanbul, Turkey

Abstract: Wildlife inventories are very new in Turkey. Thus, there is no enough data about red deer and roe deer population. However, these studies have gained momentum in recent years. In this study, it is aimed to determine and to monitor status of red deer and roe deer population densities. In the study, it was used a kind of drive count which was combined with point count. The study was conducted between 2003 and 2010 in October, once a year. Red deer and roe deer densities were determined between 0.45 and 1.19 red deer/km², 1.48 and 2.05 roe deer/km². Also, average of annual growth rates were estimated for red deer (0.135) and roe deer (-0.0059). The study showed that whilst the red deer population has been increasing, roe deer population has been decreasing in long term period.

Key words: Red deer, roe deer, population density, wildlife reserve, annual growth, Turkey

INTRODUCTION

In wildlife management, all decisions and best management can be succeeded require information on density, on trend in density or on both (Caughley and Sinclair, 1994; Siddique Awan *et al.*, 2004; Gundogdu, 2011). Knowledge of population size and population structure is essential for the development of effective management strategies for deer populations (Marques *et al.*, 2001). Research into deer density and distribution helps in the selection of suitable additional feeding places (Qureshi *et al.*, 2004; Costa *et al.*, 2006). It also might be used to protect artificial plantations and naturally regenerating stands against browsing damage and to assist in rational game management in areas where the abundance of the deer populations controlled by culling (Prokesova *et al.*, 2006).

To estimate density of wildlife populations, many models are developed, based on direct counts or indirect counts, e.g., line transects, quadrats, drive counts, point counts, aerial counts, mark-recapture and pellet counts (Al-Hashem, 2009; Pudyatmoko *et al.*, 2009). The presence of *Cervidae* species in Anatolia dates back early Pleistocene. Deer were domesticated by Hittites and first record of deer farm was found around 2000 years ago in Bogazkoy-Hattusas. Wildlife habitats and populations were always under pressure of human activities, especially illegal hunting and habitat destructions for many years in Anatolia. In Turkey, *Cervidae* family has three species, red deer (*Cervus elaphus* L., 1758), roe deer (*Capreolus capreolus* L., 1758) and Fallow deer

(*Dama dama* (L., 1758)). Having involved in the study area *Cervus elaphus* and *Capreolus capreolus* population density and numbers were investigated in the research. *Cervidae* density has increased throughout Europe and North America (Milner *et al.*, 2006). According to Kumbasli *et al.* (2010) deer populations in Turkey have been decreasing during the last 100-200 years because of uncontrolled hunting. Since, wildlife inventories are new in Turkey, there is no enough data about deer population. However, these studies have gained momentum in recent years. First study about red deer density and ecology was made by Ogurlu in Caticik-Eskisehir between 1989 and 1991. In this study, the population density was found 4.01/km² by pellet counts.

According to Baskaya, the habitat where red deer can live is around 50000 km², roe deer is around 100000 km² but the number of red deer is 7000 and roe deer is 15000 in Turkey. In addition, The number of red deer and roe deer are tried to increase in their natural habitat because of their lower density. For this reason, Wildlife Reserves and wildlife breeding stations were established in Turkey. Wildlife populations need adequate quantity and quality of available resources for their survival (Patthey, 2003). Deer distribution is influenced by climatic factors, habitat structure, vegetation structure and food supply (Prokesova *et al.*, 2006; Adrados *et al.*, 2008). In Yedigoller region, it was conducted short-term wildlife counting study between 2003 and 2005 (Beskardes, 2009). However, if it is required to evaluate and improve a wildlife population, it should be monitored long-term period or counting processes should be never given up.

Thus, the counting study was continued in the study area after 2005, between 2006 and 2010. To determine the density of deer population was used a kind of drive count which was combined with point count in the study area.

MATERIALS AND METHODS

Study site: Yedigöller-Yesilöz Wildlife reserve is located between 31°25'00"-31°55'00"E longitudes and 41°05'00"-40°50'00"N latitudes (Fig. 1). The study area is a protected area and hunting except for game tourism is prohibited entirely. Total 4-6 red deer and 6-8 roe deer are given as hunting quota yearly for game tourism in the area. In addition, the study area and its surroundings are a typical part of the Western Black sea region's high mountainous nature. The less rainy Black sea region climate is dominant in the area. For 71 years, the annual mean temperature is 10.2°C with the lowest temperature at 34°C and the highest temperature at 39.4°C. The annual mean precipitation is 536 mm and average number of the rainy days is 137.7 day year⁻¹. The altitude of the study area changes from 240-1982 m.

The vegetation in the study area can be represented variety of the layers, e.g., herb, shrub and tree layers. Also this feature provides the animals feeding in all seasons in the study area. The main plant species determined in the area including Beech (*Fagus sylvatica* ssp. *orientalis*), Fir (*Abies nordmanniana* ssp. *bornmülleriana*), oaks (*Quercus cerris*, *Q. frainetto*, *Q. petraea* and *Q. pubescens*), Scots pine (*Pinus sylvestris*),

Austrian pine (*Pinus nigra*), Hornbeams (*Carpinus betulus* and *Carpinus orientalis*). The other important tree and shrub species are Common alder (*Alnus glutinosa*), strawberry tree (*Arbutus unedo*), Ash (*Fraxinus excelsior*), Cornelian cherry (*Cornus mas*), Mediterranean medlars (*Crataegus orientalis*, *Crataegus pentagyna*), European aspen (*Populus tremula*), European holly (*Ilex aquifolia*), Hazel (*Coryllus avellana*), Linden (*Tilia tomentosa*), Walnut (*Juglans regia*), Apple (*Malus sylvestris*), Maple (*Acer campestre*), Oriental plane (*Platanus orientalis*), Cherry (*Prunus avium*), English laurel (*Prunus laurocerasus*), Ornamental pear (*Pyrus eleagnifolia*), Rhododendron (*Rhododendron ponticum*), Grey willow (*Salix cinerea*), *Smilax excelsa*, Common yew (*Taxus baccata*) and Field elm (*Ulmus minor*).

Counting method: Since, the study area is 50950 ha large, determining the entire area for wildlife populations' density and size has always required considerable amounts of time and money. Thus, it was decided to use sampling method in the study. First, wildlife reserve's 1/25000 scaled maps were used to create a grid consisting of 509 units; each 100 ha total 50900 ha. Among 509 sample areas, 62 sample units represented 12.14% of the total area determined by randomly and considering financial means. Later on, the sample areas were examined on the field and their borders, streams and roads were drawn on the map. The map was digitalized in a GIS Program.

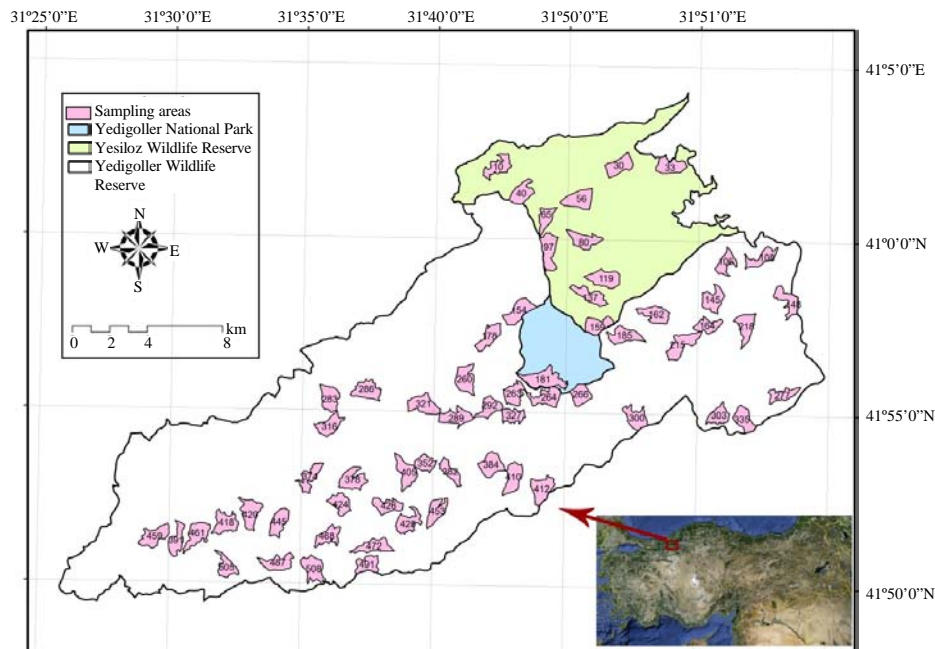


Fig. 1: Yedigöller-Yesilöz Wildlife Reserve sampling area

Table 3: Estimated red deer and roe deer numbers and densities

Type of deer	Total				Animal density (per 100 ha)
	(individual)	Male	Female	Calves	
Red deer					
\hat{N}_{d2003}	224±154	83	133	8	0.44
\hat{N}_{d2004}	239±119	91	148	0	0.47
\hat{N}_{d2005}	361±153	164	189	8	0.71
\hat{N}_{d2006}	494±249	148	288	58	0.97
\hat{N}_{d2007}	484±200	197	213	74	0.95
\hat{N}_{d2008}	519±260	181	223	115	1.02
\hat{N}_{d2009}	606±195	205	278	123	1.19
\hat{N}_{d2010}	575±267	181	263	131	1.13
Roe deer					
\hat{N}_{r2003}	896±220	271	543	82	1.76
\hat{N}_{r2004}	753±189	230	311	213	1.48
\hat{N}_{r2005}	937±160	280	493	164	1.84
\hat{N}_{r2006}	886±136	271	468	148	1.74
\hat{N}_{r2007}	840±138	296	428	116	1.65
\hat{N}_{r2008}	779±132	279	328	172	1.53
\hat{N}_{r2009}	1043±171	394	419	230	2.05
\hat{N}_{r2010}	860±133	393	336	131	1.69

\hat{N}_d : Red deer; \hat{N}_r : Roe deer

Table 4: Annual growth rate of red deer and roe deer

Years	r_m red deer	r_m roe deer
2004	0.06486100	-0.17399300
2005	0.41269400	0.21876600
2006	0.31387000	-0.05600400
2007	-0.02046400	-0.05335100
2008	0.06986600	-0.07544200
2009	0.15508100	0.29204300
2010	-0.05254600	-0.19305500
Average	0.13476624	-0.00586226

$$\sqrt{\frac{N-n}{N-1}} = 0.938$$

In 2009, determined the number and density of red deer and roe deer was higher than the other years was 74 red deer and was 127 roe deer. In 2004, red deer calve was not observed and one calve was determined in 2003 and 2005. The means of red and roe deer populations were estimated for red deer min. 0.44 and max. 1.19; for roe deer min. 1.48 and max. 2.05 (Table 2).

In this study, it was estimated red and roe deer numbers for whole study area. The estimated numbers of red deer and roe deer were shown in Table 3. Their annual growth rates were shown in Table 4. According to Table 4, average of annual growth rates were estimated for red deer (0.135) and roe deer (-0.0059). In addition, the growth rate of red deer was found as decreasing and growth rate of roe deer was found as independent for 8 years.

The results of the counting done over eight years at the Wildlife Reserve were applied to ANOVA and Test of Homogeneity of Variance for red deer and roe deer. Since, their significance levels were found >0.05 and the results were applied to Non-Parametric Methods Kruskal-Wallis H test of K-Independent Sample tests. According to Kruskal Wallis test, it was found for red deer (Asymp. Sig.

0.029), for roe deer (Asymp. Sig. 0.344). To evaluate about wildlife population increasing or decreasing or its trend, it should be monitored for many years. In terms of this, the study provides important results about red deer and roe deer numbers and their density and represents as an important model for the other Wildlife Reserves in Turkey. The estimated number of red deer was found as 575±267 and density was 1.13 deer/km² in 2010. The average of red deer density for 8 years is 0.54/km². In Europe, red deer density per km² has changed between 2 and 10 animals/km². The highest density was found in Liechtenstein (2.81 animals/km²), Austria (1.79), UK (1.47) and Luxembourg (1.23) (Burbaite and Csanyi, 2009). Although, the Wildlife Reserve is a protected area, the density of red deer in Wildlife Reserve is lower than European countries.

Red deer carrying capacity of a forest changes according to many researchers but the minimum of carrying capacity was given between 2 and 3 red deer/km² by Bruinderink and Lammertsma (1997), Ratcliffe (1997), Palmer *et al.* (1997) and Baleisis and Bluzma (1999). Thus, the study area is thought not to be reached to the carrying capacity of red deer because red deer density was found 1.13 red deer/km² in 2010.

Between 2003 and 2005, calves of red deer were not observed during the counting. Red deer calves might have been hidden by lying in the vegetations during the counting. Thus, calves weren't detected by both drivers and observers. Also red deer numbers were found lower than the other years.

The estimated number of roe deer was found as 860±133 and density was 1.69/km² in 2010. The average of roe deer density is 1.72/km² for 8 years. According to Burbaite and Csanyi (2009) roe deer density in Denmark (9.28 animals km⁻²), Luxembourg (9.27), Austria (8.94), Germany (8.40), in Europe, average of density is 1.55 animals per km². Although, the average of roe deer density in the study area was found higher than Europe's average. It should be noted that because of being a protected area, it would be expected higher numbers of roe deer density in the study area such as in Austria, Denmark and Germany.

The result of the Kruskal-Wallis test showed that significance levels were found for roe deer (Sig. 0.344) and red deer (Sig. 0.029). Consequently, the change of red deer population was found as significant but the change of roe deer population wasn't found as significant. The averages of annual growth rate of these species were examined for 7 years. This rate was estimated for red deer as 0.135 and for roe deer as 0.0059. This result means that whilst red deer population has been increasing and the roe deer population has been decreasing for long term period (Table 4). Roe deer numbers has declined in Europe only a few countries, two possible reasons could be

responsible for this: the insufficient data and high level poaching (Burbaite and Csanyi, 2009). Since, roe deer gives birth as twins a year (Danilkin and Hewison, 1996) and normally population density can be expected to increase for long term period. Although, many predator species such as wolf and jackal live in the study area but the responsible of decreasing roe deer population can be thought as poaching is a reality of the study area. Poaching has been done mostly by the villagers and forestry workers from villages around the Wildlife Reserve. Since, red deer prefer to live in the center of the Wildlife Reserve where is far from the villages. Also there is a national park called Yedigöller National Park in the center of the Wildlife Reserve, provides better protection than outer line of Wildlife Reserve. Poachers avoid hunting around the national park because of the visitors and recreational usage of national park.

CONCLUSION

In this study it is aimed to determine and monitor deer density in Wildlife Reserve for long term period. According to the study results although, red deer density has increased and roe deer density has showed fluctuation, both red deer and roe deer' density of the study area can be thought lower than carrying capacity. To improve both red deer and roe deer density, adequate conservation management should be implemented in the area.

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REFERENCES

- Adrados, C., C. Baltzinger, G. Janeau and D. Pepin, 2008. Red deer *Cervus elaphus* resting place characteristics obtained from differential GPS data in a forest habitat. Eur. J. Wildl. Res., 54: 487-494.
- Al-Hashem, M., 2009. Effects of oil pollution on the population size of the desert lizard *Acanthodactylus scutellatus* and their ant prey at Kuwait's Al-burgan oil field. J. Biol. Sci., 9: 682-686.
- Baleisis, R. and P. Bluzma, 1999. State of the red deer population, its dynamics and impact on the habitats on the zagare botanical-zoological reserve. Acta Zool. Lithuanica, 9: 49-54.
- Bruinderink, G. and D.R. Lammertsma, 1997. Management of red deer in netherlands, population ecology. Proceedings of the Population Ecology Management and Welfare of Deer, April 1997, The Manchester Metropolitan University, Manchester, pp: 88-94.
- Burbaite, L. and S. Csanyi, 2009. Roe deer population and harvest changes in Europe. Est. J. Ecol., 58: 169-180.
- Caughley, G. and A.R.E. Sinclair, 1994. Wildlife Ecology and Management. 5th Edn., Blackwell Science, Massachusetts, Pages: 334.
- Costa, S.S., D.B. Oliveira, A.M. Manco, G.O. De Melo and J.L.P. Cordeiro *et al.*, 2006. Plants composing the diet of marsh and pampas deer in the Brazilian pantanal wetland and their ethnomedicinal properties. J. Boil. Sci., 6: 840-846.
- Danilkin, A. and A.J.M. Hewison, 1996. Behavioural Ecology of Siberian and European Roe Deer. Chapman and Hall, London, UK., Pages: 277.
- Gundogdu, E., 2011. Population size, structure and behaviours of wild goat in cehennemdere wildlife improvement area. Asian J. Anim. Vet. Adv., 6: 555-563.
- Kumbasli, M., E. Makineci And M. Cakir, 2010. Long term effects of red deer (*Cervus elaphus*) grazing on soil in a breeding area. J. Environ. Biol., 31: 185-188.
- Marques, F.F.C., S.T. Buckland, D. Goffin, C.E. Dixon, D.L. Borchers, B.A. Mayle and A.J. Peace, 2001. Estimating deer abundance from line transects survey of dung: Sika deer in Southern Scotland. J. Applied Ecol., 38: 349-363.
- Milner, J.M., C. Bonenfant, A. Mysterud, J.M. Gaillard, S. Csanyi and N.C. Stenteth, 2006. Temporal and spatial development of red deer harvesting in Europe: Biological and cultural factors. J. Applied Ecol., 43: 721-734.
- Palmer, S.C.F., I.S. Paterson, M. Marquiss and B.W. Staines, 1997. The impact of deer browsing on regeneration of scots pine: A preliminary study. Proceedings of the Population Ecology Management and Welfare of Deer, April 1997, Manchester Metropolitan University, Manchester, pp: 48-53.
- Patthey, P., 2003. Habitat and corridor selection of an expanding red deer (*Cervus elaphus*) population. Ph.D. Thesis, Institute of Ecology, University of Lausanne.
- Prokesova, J., M. Barancekova and M. Homolka, 2006. Density of red and roe deer and their distribution in relation to habitat characteristics in a floodplain forest. Folia Zool., 55: 1-4.
- Pudyatmoko, S., Kaharuddin and S. Nurvianto, 2009. Role of urban environment on conservation of birds diversity in Java, Indonesia. J. Biol. Sci., 9: 345-350.

- Qureshi, B.D., M.S. Awan, A.A. Khan, N. Iftikhar Dar and M. Ejaz-ul-Islam Dar, 2004. Distribution of himalayan musk deer (*Moschus chrysogaster*) in Neelum valley, district Muzaffarabad, Azad Jammu and Kashmir. *J. Biological Sci.*, 4: 258-261.
- Ratcliffe, P.R., 1997. Woodland deer management: Integrating the control of their impact with multiple objective forest management in Scotland. *Proceedings of the Population Ecology Management and Welfare of Deer*, April 1997, Manchester Metropolitan University, Manchester, pp: 67-72.
- Siddique Awan, M., A. Ahmed Khan, K. Basharat Ahmed, M. Ahmed Qureshi, M. Ahmed Malik and N. Iftikhar Dar, 2004. Population dynamics of cheer pheasant (*Catreus wallichii*) in Jhelum Valley, Muzaffarabad, Azad Kashmir, Pakistan. *Pak. J. Biol. Sci.*, 7: 789-796.
- Williams, B.K., J.D. Nichols and M.J. Conroy, 2001. *Analysis and Management of Animal Populations, Modeling, Estimation and Decision Making*, Academic Press, London, Pages: 817.