

Mongolian Saiga in Sharga Nature Reserve: Are Domestic Dogs a Threat to Saiga?

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Absract

Dogs (*Canis familiaris*) are recognized as one of the most numerous carnivores in the world. They have direct and indirect impacts on a diverse range of animal species. In Mongolia, there are shepherd families within Mongolian saiga (*Saiga tatarica mongolica*) range and shepherd dogs are suspected to cause saiga mortalities. However, quantitative information on the effects of dogs on saiga is lacking. In August 2008 and April 2009, we estimated abundance of dogs in Sharga Nature Reserve by compiling existing data and interviewing local people to understand public perceptions regarding impacts of dogs on saiga. Interviews revealed that the majority of local herders believed dogs have only a minor impact on saiga due to the low density of domestic dogs and the lack of feral dogs in the reserve. However, dogs are believed to have greater impacts on saiga in harsh winters, when saiga are in poorer health and are more likely to use areas where dogs are present. Thus, domestic dogs in the study area appear to have no regular detrimental impact on the local saiga population, but may act as a source of additive mortality in years with harsh winter conditions.

Key words: feral and free-roaming dogs, *Saiga tatarica mongolica*, Shargyn Gobi, Mongolia

Introduction

The saiga antelope (*Saiga tatarica*) is categorized as Critically Endangered on the IUCN Red List (IUCN, 2009), and listed within CITES & CMS conventions. There are two distinct saiga subspecies (Kholodava *et al.*, 2006): *S. tatarica tatarica*, distributed in the pre-Caspian region countries including Kazakhstan, Russia, Uzbekistan, and Turkmenistan and *S. tatarica mongolica*, distributed in western Mongolia. The Mongolian saiga (*S. tatarica mongolica*) has been isolated from main populations in the pre-Caspian region by the massive Altai Mountains. The number of saiga in Mongolia fluctuated between c. 750 – 5,000 individuals in the last decade (Amgalan *et al.*, 2008). The most recent population estimate using distance sampling showed that over 7000 saiga occupied the area in and around Sharga Nature Reserve in western Mongolia (Fig. 1; Young *et al.*, in press). In Mongolia, saiga have been legally protected since 1953, and are included in the Mongolian Red Book Data. The major factors limiting Mongolia's

saiga population include poaching, recurrent harsh winters, pasture degradation by excessive livestock, and possibly predation including by domestic dogs (*Canis familiaris*; Nyambayar & Amgalan, 1999; Lushchenkina *et al.*, 1999; Clark & Javzansuren, 2006; Young, 2008).

Dogs are recognized as the most numerous carnivore in the world today (Daniels & Bekoff, 1989); at approximately 500 million worldwide, dogs outnumber all other canids (Veitch, 2002). They have direct and indirect impacts on a wide variety of endemic species in several ways. First, dogs have evolved as top predators in many ecosystems and hunt a wide range of fauna (e.g. Macdonald & Sillero-Zubiri, 2004; Nelson & Mech, 1986; Linnell *et al.*, 1995; Butler & Bingham, 2000). Second, dogs can interbreed with wolves and produce fertile offspring (Vila & Wayne, 1999), which dilutes the genetic stock of wolves and further imperils their survival (Laurenson *et al.*, 1998). Third, disturbance caused by dogs alters behavior of wildlife by increasing flight distance (Yalden & Yalden, 1990; Mainini *et al.*, 1993), decreasing foraging time (Childress

& Lung, 2003; Hunter & Skinner, 1998), and lowering reproduction rates (Gingold *et al.*, 2009). Finally, dogs are reservoirs of infectious diseases that detrimentally impact wildlife and human welfare (Pain, 1997; Kitala *et al.*, 2000; Matter *et al.*, 2000; Segelken, 2002).

Understanding sources of mortality for Mongolian saiga is critical to the long-term survival of the species. Predation by domestic and free-roaming dogs is one of the potential sources of herbivore animal mortality. Saiga populations suffer considerable damage from the large number of sheep dogs and free-roaming dogs found throughout Kazakhstan (Bekenov *et al.*, 1998). According to Sludskii (1962), more than 10,000 saiga calves were killed every year by dogs in Betpak-dala, Kazakhstan. Although there are families with dogs in saiga range areas of Mongolia, the impacts of domestic dogs on saiga are unknown. The major goals of this research are to estimate number and density of dogs in Sharga Nature Reserve and to evaluate public attitude of local herders regarding the perception of dog-saiga issues.

Materials and Methods

Study area. We conducted our survey in Sharga Nature Reserve (SNR), southwestern Gobi-Altai Aimag (province), which is 3,088 km² in land area. The main human populations in the area are

concentrated in villages called soums (town) and SNR encompasses 4 soums' territories of Gobi-Altai Aimag including Tugrug, Sharga, Tonkhil and Darvi (Fig. 1). The climate is strongly continental and arid, characterized by cold winters (to -45°C), dry and windy springs, and relatively wet and hot summers (to 40°C). Annual precipitation averages ca. 100 mm. Grasses (*Stipa spp.*), onions (*Allium spp.*), and *Anabasis brevifolia* dominate this region. Some shrubs (*Caragana spp.*) and trees, such as saxaul (*Haloxylon ammodendron*) are sparsely distributed. The other antelope species in SNR is goitered gazelle (*Gazella subgutturosa*). Gray wolves (*Canis lupus*), red fox (*Vulpes vulpes*), corsac fox (*Vulpes corsac*), and raptors, such as golden eagles (*Aquila chrysaetos*) and cinereous vulture (*Aegiphus monachus*) occur in SNR and are known to prey on saiga.

Interview survey. Abundance and density of feral and free-roaming dogs was derived by the number of herders. To do so, we estimated the number and density of domestic dogs that occupy SNR seasonally by multiplying the total number of herders by the minimum, average, and maximum number of dogs each herder family owned. These numbers were obtained during the interview surveys. Although we use the average for estimating density, the minimum and maximum values provide a range of possible values in the absence of data to produce a confidence interval. Dog density was then calculated by dividing the

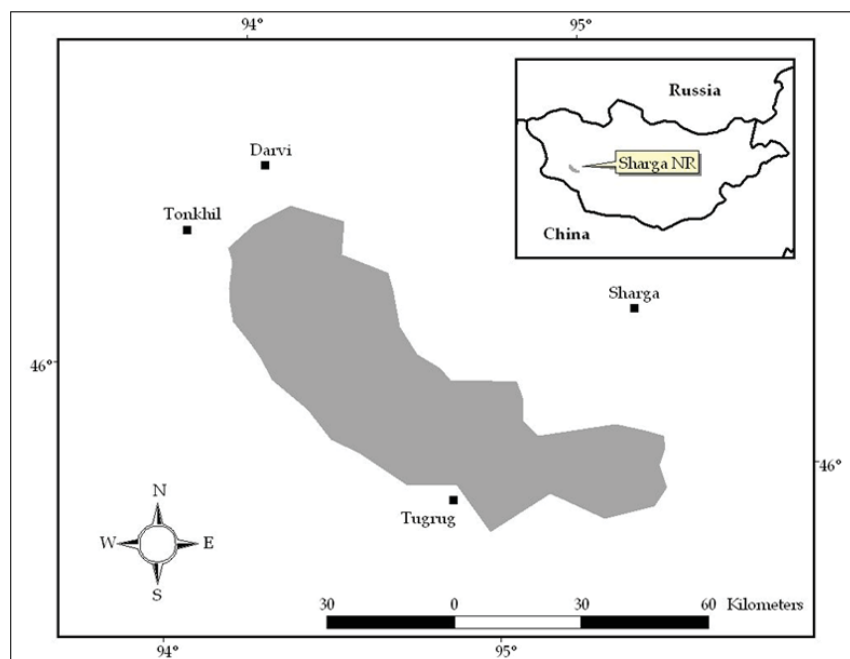


Figure 1. Map of Sharga Nature Reserve and adjacent soums in western Mongolia.

average number dogs by area of SNR. The number and distribution data of herders in the study area throughout the year was obtained from a database of the WWF Mongolia Office.

We interviewed 62 people (53 local herders, 5 saiga rangers, and 4 soum inspectors). A questionnaire was used to provide respondents with an opportunity to share their perception regarding direct and indirect impacts of dogs on saiga. The questionnaire had both open-ended and closed questions. The following information was collected from herders: number of dogs owned, whether dog(s) roam freely, their experience with harassment and predation of dogs on saiga, and their views of the impact of dogs. We used Kruskal-Wallis Test to assess differences in number of dogs among seasons. MINITAB 13.0 software was used for all statistical analysis. Values are presented as average \pm standard deviation.

Results

The abundance of dogs in Sharga Nature Reserve. Number of dogs owned by herders was 1.2 ± 0.1 ($n=62$) during the surveys. In total, 287 (Range = 239 – 717) dogs are in SNR throughout the year (Table 2). Among four seasons, the number of dogs averaged 71.8 ± 51.7 (Range = 18 – 136) at a density of 0.02 ± 0.01 (Range = 0.00 – 0.04) dogs per km² (Table 1). There was no significant difference in number of dogs among

seasons (Kruskal-Wallis test: $H = 3.38$, $p = 0.33$). The data from inspectors in four soums showed that 2,213 dogs were counted in 2009. During the last three years, 482 stray dogs have been killed in four soums (Table 2).

Public perceptions toward impact of dog on saiga antelope. Seventeen percent of respondents indicated that dogs they owned roam freely, with a range of 1.3 ± 0.7 km. Eleven saiga mortalities were reportedly caused by domestic dogs. Of these, eight saiga were adults killed in winter and three were calves predated in summer. Despite the fact that most of the reported cases of dog predation occurred in winter, the majority (83%) of respondents believe dogs are potentially a threat to saiga in summer. Only 11% and 6% of respondents thought that dogs are a danger to saiga in spring and winter, respectively. No one believed dogs are a threat to saiga in autumn even though the number of dogs is highest in SNR during autumn. Approximately 10% of herders interviewed answered that they are accompanied by one or more dogs when they spend time in field with livestock. However, no respondents indicated that dogs accompany sheep and goats without humans. Only 25% of respondents have witnessed dogs harassing saiga. The largest number (38%) of respondents indicated that raptors, including golden eagle and black vulture are the leading predator species on both adult and newborn saiga. Dogs accounted for only 2% of respondents of

Table 1. Number and density of dogs during 2008-2009, in Sharga Nature Reserve.

Seasons	# Herders	# Dogs	Density (per km-2)
Winter	38	46 (38 - 114)	0.01 (0.01 - 0.03)
Spring	72	86 (72 - 216)	0.02 (0.02 - 0.06)
Summer	15	18 (15 - 45)	0.00 (0.00 - 0.01)
Autumn	114	137 (114 - 342)	0.04 (0.03 - 0.11)
Total	239	287 (239 - 717)	0.09 (0.01 - 0.05)

Table 2. Number of dogs, killed and alive, in soums adjacent to Sharga Nature Reserve.

Soums	# of stray dogs killed				# dogs counted
	2006	2007	2008	Σ	
Darvi	60	57	65	182	498
Tonkhil	35	35	23	93	750
Tugrug	30	25	30	85	552
Sharga	44	35	43	122	413
Total	169	152	161	482	2213

potential predators. Finally, when we asked “Are dogs a threat to saiga?” a large majority (91%) of herders in SNR believed dogs are not a threat.

Discussion

Feral dogs are highly social, living in constant packs year round (Daniels & Bekoff, 1989; Gipson, 1983), and they are known as effective predators of wildlife, including reptiles, birds, and mammals (Gipson, 1983). In the southeastern USA, feral dogs have been observed to form packs, behave aggressively, and kill wildlife (Scott, 1973). Dogs successfully hunt elk in the forest of Northern America (Lowry & McArthur, 1978). Further, feral dogs in the Mediterranean coastal plain in Israel have led to a decline in the breeding success of mountain gazelles (*Gazella gazelle*; Manor & Saltz, 2004). Feral dogs are largely absent in SNR due to an active campaign that limits the number of stray dogs. Based on the records of the counties’ inspectors a total of 482 stray dogs were killed in the last three years. Instead, most unattended dogs are free-roaming guard dogs. Guard dogs may have similarly detrimental impacts to local wildlife populations; they have direct and indirect effects on mountain gazelles in enclosures by altering gazelle behavior and decreasing reproduction rate (Gingold *et al.*, 2009). Yet, interview results showed only 10 respondents allowed their dogs to roam freely. In these cases, the dogs were believed to remain within a range of < 1.2 km.

Daniels & Bekoff (1989) suggest that urban and rural dogs are predominantly solitary, and other studies indicate dogs avoid conspecifics (Beck, 1973; Daniels, 1983). Urban and rural dogs exhibit territorial behavior restricted to the home site (Daniels & Bekoff, 1989) because food is provided by the owner. Fox *et al.* (1975) suggested that the availability of food is a determining factor in the size of the home ranges of dogs. In our study, most dogs likely remain near their home site because local herders feed their dogs leftovers daily. In addition, the area of SNR has very low density of potential prey animals such as hare and few species of rodents (Amgalan, *pers.com*). Further, fragmentation (Manor & Saltz, 2004) and garbage dumps (Daniels & Bekoff, 1989; Lacerda *et al.*, 2009) may create an influx of dogs entering neighboring protected areas, but neither is in SNR.

The winter season presents significant challenges for survival of many species in northern latitudes. For ungulates, the stresses imposed by deep snow, food shortages, and low ambient temperatures combine to depress body condition (Sime, 1999). The climate of SNR is strongly continental. Local people reported that saiga move from the Gobi into higher elevations to avoid deep snow and blizzards. Herders also reported that dogs have an advantage to catch saiga because saiga do not normally run in mountains. Thirteen percent of interviewees witnessed depredation of dogs on saiga in late winter. In Kazakhstan, substantial numbers of weak saiga, which had approached human settlements, were killed by dogs during the harsh winter (Bekenov *et al.*, 1998). In North America, crusted snow enables domestic dogs to successfully kill deer in winter (Lowry & McArthur, 1978). Similarly, dogs frequently prey on argali sheep (*Ovis ammon*) in the late winter in Ikh Nart National Park, Mongolia when argali are in their weakest physical condition (Reading *et al.*, 2001). Local herders in Shargyn Gobi reported that their dogs are unable to capture saiga at other times of the year because the dogs can not run as fast as healthy saiga. Findings from these results suggest that saiga predation by domestic dogs occurs when harsh winters accompanied by deep snow weakens the physical condition of saiga, makes them less able to run, and pushes saiga into areas where domestic dogs are present.

During summer, predation concerns are primarily related to the birth and rearing of young for wildlife. Several studies emphasize that neonate ungulate predation by free-roaming dogs may have a minor effect on ungulate population dynamics (e.g. Nelson & Mech, 1986; Linnell *et al.*, 1995; Ballard *et al.*, 1999; Butler & Bingham, 2000). In Betpak-dala, > 10,000 saiga calves were killed by dogs every year (Sludskii, 1962). However, no study exists regarding dog predation on saiga calf in recent decades. The main parturition peak of saiga in Mongolia is in June (Dulamceren & Amgalan, 1994; Young *et al.*, 2009). Although there was no significant difference among the seasons in the number of dogs in SNR, the density was lower in summer. Herders move up to the mountains in summer to escape the heat and lack of water in SNR. Thus, dog predation on saiga calves is likely incidental. Further, there was no dog predation on radio-collared saiga calves (Young *et al.*, unpublished data). In fact, only

three respondents (4.8%) witnessed dogs preying on <1 week old saiga calves.

Dogs and saiga occur in low density throughout SNR and it is unclear if such conflicts are more common than reported in our interviews. Local herders informed us that the dogs do not accompany goat and sheep unless humans are also present. Although it appears that dogs are not causing significant mortality of saiga in this system, discrepancies in interview responses (e.g., observations of dogs killing saiga, but response that dogs are not free-roaming) warrant further investigation of saiga-dog interactions. Further studies that directly monitor spatial patterns of saiga and dogs in areas where they overlap are needed (Buuveibaatar *et al.*, 2009). In addition, interviews with herders should be conducted in other saiga ranges to determine the extent of this issue.

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References

- Amgalan, L., Buuveibaatar, B. & Chimeddorj, B. 2008. Current distribution and number of the Mongolian saiga (*Saiga tatarica mongolica*). *Proc. Inst. Biol. Mong. Ac. Sci.*, 27: 4-6 (in Mongolian).
- Ballard, W. B., Whitlaw, H. A., Young, S. J., Jenkins, R. A. & Forbs, G. J. 1999. Predation and survival of white-tailed deer in north central New Brunswick. *J. Wild. Manag.*, 63: 574-579.
- Beck, A. M. 1973. *The Ecology of Stray Dogs*. York Press, Baltimore, MD.
- Bekenov, A. B., Grachev, U. A. & Milner-Gulland, E. J. 1998. The ecology and management of the saiga antelope in Kazakhstan. *Mammal Rev.*, 28: 1-52.
- Butler, J. R. A. & Bingham, J. 2000. Demography and dog-human relationships of the dog population in Zimbabwean communal lands. *Vet. Record.*, 147: 442-446.
- Buuveibaatar, B., Young, J. K. & Fine, A. E. 2009. Research on the potential effects of domestic dogs on Mongolian Saiga in Shargyn Gobi NR, Mongolia. *Saiga News*, 9: 15-16.
- Childress, M. J. & Lung, M. A. 2003. Predation risk, gender and the group size effect: does elk vigilance depend upon the behaviour of conspecifics? *Anim. Behav.*, 66: 389-398.
- Clark, E. L. & Javzansuren, M. 2006. *Mongolian Red List of Mammals*. Dulamtseren, S., Baillie, J. E. M., Batsaikhan, N., Samiya, R. & Stubbe, M. (eds). Zoological Society of London, London, UK, 65 pp.
- Daniels, T. J. & Bekoff, M. 1989. Population and social biology of free-ranging dogs, *Canis familiaris*. *J. Mammal.*, 70: 754-762.
- Dulamceren, S. & Amgalan, L. 1994. Data on the reproduction of Mongolian saiga antelope (*Saiga tatarica mongolica* Bannikov 1946). *Beitrag zur Jagd- und Wildforschung, Bd. 19*: 125-127.
- Fox, M.W., Beck, A. M. & Blackman, E. 1975. Behavior and ecology of a small group of urban dogs *Canis familiaris*. *Appl. Anim. Ethol.*, 1: 119-137.
- Gingold, G., Yom-Tov, Y., Kronfeld-Schor, N. & Geffen, E. 2009. Effect of guard dogs on the behavior and reproduction of gazelles in cattle enclosures on the Golan Heights. *Anim. Conserv.*, 12: 155-162.
- Gipson, P. S. 1983. Evaluations of behavior of feral dogs in interior Alaska, with control implications. *Vertebr. Pest Control Manage. Mater. 4th Symp. Am. Soc. Testing Mater.* 4: 285-294.
- Hunter, L. T. B. & Skinner, J. D. 1998. Vigilance behavior in African ungulates: the role of predation pressure. *Behavior*, 135: 195-211.
- IUCN 2009. IUCN Red List of Threatened Species. Version 2009.1. www.iucnredlist.org.
- Kholodova, M. V., Milner-Gulland, E. J., Easton, A. J., Amgalan, L., Arylov, I. A., Bekenov, A., Grachev, I. A., Lushchekina, A. A. & Ryder, O. 2006. Mitochondrial DNA variation and population structure of the Critically Endangered saiga antelope *Saiga tatarica*. *Oryx*, 40: 103-107.
- Kitala, P. M., McDermott, J. J., Kyule, M. N., Gathuma, J. M. 2000. Community based active surveillance for rabies in Machakos District, Kenya. *Preventive Vet. Med.*, 44: 73-85.

- Lacerda, A. C. R., Tomas, W. M., Marinho-Filho, J. 2009. Domestic dogs as an edge effect in the Brasilia National Park, Brazil: interactions with native mammals. *Anim. Conserv.*, 12: 477-487
- Laurenson, K., Sillero-Zubiri, C., Thompson, H., Shiferaw, F., Thirgood, S. & Malcolm, J. 1998. Disease as a threat to endangered species: Ethiopian wolves, domestic dogs and canine pathogens. *Anim. Conserv.*, 1: 273-280.
- Linnell, J. D. C., Aanes, R. & Andersen, R. 1995. Who killed Bambi? The role of predation in the neonatal mortality of temperate ungulates. *Wildlife Biol.*, 1: 209-223.
- Lowry, D. A. & McArthur, K. L. 1978. Domestic dogs as predators on deer. *Wildlife Soc. Bull.*, 6: 38-39.
- Lushchekina, A. A., Dulamtseren, S., Amgalan, L. & Neronov, V. M. 1999. The status and prospects for conservation of the Mongolian saiga, *Saiga tatarica mongolica*. *Oryx*, 33: 21-30.
- Macdonald, D. W. & Sillero-Zubiri, C. 2004. *Biology and conservation of wild canids*. Oxford University Press, Oxford, UK, 58-61 pp.
- Manor, R. D. & Saltz, D. 2004. The impact of free-roaming dogs on gazelle kid/female ratio in a fragmented area. *Biol. Conserv.*, 119: 231-236.
- Mainini, B., Neuhaus, P. & Ingold, P. 1993. Behavior of marmots *Marmota marmota* under the influence of different hiking activities. *Biol. Conserv.*, 64: 161-164.
- Matter, H. C., Wandeler, A. I., Neuenschwander, B. E., Harischandra, L. P. A. & Meslin, F. X. 2000. Study of the dog population and the rabies control activities in the Mirigama area of Sri Lanka. *Acta Tropica*, 75: 95-108.
- Nelson, M. E. & Mech, L. D. 1986. Mortality of white-tailed deer in north-eastern Minnesota. *J. Wild. Manag.*, 4: 691-698.
- Nyambayar, B. & Amgalan, L. 1999. *Mongolian saiga conservation management plan*. Ministry of Nature and Environment, WWF Mongolian Country Office. Ulaanbaatar, Mongolia, 20-23 pp.
- Pain, S. 1997. The plague dogs. *New Science*, 154: 32-37.
- Reading, R. P., Amgalanbaatar, S., Kenny, D., Onon, Y., Namshir, Z. & DeNicola, A. 2006. Argali ecology in Ikh Nartiin Chuluu Nature Reserve: preliminary findings. *Mon. J. Biol. Sci.*, 1(2): 3-14
- Scott, M. D. & Causey, K. 1973. Ecology of feral dogs in Alabama. *J. Wild. Manag.*, 37: 253-265.
- Segelken, R. 2002. *Deadly dog virus appears in surprising species, not just*. Cornell News 2/10/02.
- Sime, C. A. 1999. Domestic Dogs in Wildlife Habitats. In Joslin G. & Youmans H. (eds): *Effects of recreation on Rocky Mountain wildlife: A Review for Montana*. Committee on Effects of Recreation on Wildlife, Montana Chapter of The Wildlife Society, 8.1-8.17 pp.
- Sludskii, A. A. 1962. The relationship between predator and prey. *Trudi Instituta Zoologii AN KazSSR. Proc. Zool. Inst. Kaz. Ac. Sci.*, 17: 24-143.
- Veitch, C. R. 2002. *Feral dog-a situation summary*. Endangered Species Recovery Council, Papakura, New Zealand, 23-25 pp.
- Vila, C. & Wayne, R. K. 1999. Hybridization between wolves and dogs. *Conserv. Biol.*, 13: 195-198.
- Yalden, P. E. & Yalden, D. 1990. Recreational disturbance of breeding golden plovers *Pluvialis apricarius*. *Biol. Conserv.*, 51: 243-262.
- Young, J. K. 2008. Mongolian saiga conservation workshop. *Oryx*, 42: 14-15.
- Young, J. K., Murray, K. M., Strindberg, S., Buuveibaatar, B. & Berger, J. *In press*. Population estimates of Mongolian saiga: implications for effective monitoring and population recovery. *Oryx*.
- Young, J. K., Buuveibaatar, B., Fine, A. E., Lhagvasuren, B. & Berger, J. 2009. Mongolian saiga calves captured and collared. *Saiga News*, 8: 8.

Хураангуй

Гэрийн нохой (*Canis familiaris*) нь дэлхий дээр тархсан нохдын овгийн хамгийн элбэг махчин юм. Нохой нь олон зүйл зэрлэг амьтдад шууд болон дам нөлөө үзүүлдэг. Монгол бөхөн (*Saiga tatarica mongolica*)-гийн тархац нутагт малчин өрхүүдийн тоо харьцангуй өндөр бөгөөд эдгээр айлуудын ноход бөхөнгийн үхэл хорогдолд нөлөөлж болзошгүй хэмээн үздэг хэдий ч энэ талаар явуулсан судалгаа, тоон мэдээ хомс байна.

Иймээс бид Шаргын Говийн Байгалийн Нөөц Газар (ШГБНГ) дахь нохойны тоо, нягтшилыг малчин өрхийн тоонд тулгуурлан тооцоолсон ба мөн 2008 оны 8 сараас 2009 оны 4 сар хүртэлх хугацаанд нохойны бөхөнд үзүүлэх нөлөөллийн талаар малчдаас аман судалгаа авсан юм. Аман судалгаанд хамрагдсан нийт малчдын дийлэнх нь ШГБНГ дахь нохдын тоо, нягтшил харьцангуй бага тул бөхөнгийн хорогдолд нөлөө багатай хэмээн хариулсан.

Гэвч байгаль цаг агаарын хүнд нөхцөлд бөхөнгийн тарга тэвээрэг муудан, хүн малд ойртон байрших үед гэрийн нохой бөхөнг олноор барьдаг хэмээн хариулсан байна. Энэ бүхнээс дүгнэн үзэхэд ШГБНГ-т байрших бөхөнгийн хорогдолд гэрийн нохойны нөлөө бага боловч өвөл байгаль, цаг агаарын нөхцөл хүндрэн идэш тэжээл хомсдон ядарч туйлдсан үед түүний сөрөг нөлөө нэмэгддэг болох нь харагдаж байна.

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