

# Animal and human rabies in Mongolia

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Submitted on: 1 February 2008

Accepted on: 1 June 2009

## Summary

The prevalence of animal rabies differs in each area of Mongolia. Wolves (*Canis lupus* Linnaeus, 1758), foxes (*Vulpes vulpes* Linnaeus, 1758), corsac foxes (*Vulpes corsac* Linnaeus, 1768) and manuls (*Felis manul* Pallas, 1778) are considered to be the infective wild animals in natural foci. Amongst livestock, cattle have had the most rabies cases, followed by camels, sheep, goats and horses. The peak prevalence of animal rabies occurred in the 1970s. Dundgovi Province had the highest incidence during that period. The number of rabies cases in animals decreased during the 1980s. This may have been due to a decrease in the number of wild reservoir animals and the improvement of appropriate veterinary measures. In recent years, animal rabies has prevailed in the Khangai and western provinces. The infection source of most human rabies cases is the dog. In order to minimise the incidence of human rabies, canine vaccination programmes need to be improved. This paper describes the epizootiology and epidemiology of animal and human rabies in Mongolia. It describes rabies control programmes, including diagnosis, conducted in Mongolia in an effort to control the disease.

## Keywords

Corsac fox – Diagnosis – Epidemiology – Epizootiology – Fox – Manul – Mongolia – Nomadic livestock – Rabies – Vaccination – Wolf – Zoonosis.

## Introduction

Mongolia has an area of 1.5 million km<sup>2</sup> and a population of 2.6 million inhabitants. It is bordered by the Russian Federation to the north and the People's Republic of China to the south. From north to south, Mongolia comprises five geographic zones: forest (taiga), forest-steppe, steppe (grassland plain), semi-desert and desert. The western part of Mongolia is a high mountainous region and the eastern half is a lower plain area. The territory of Mongolia is divided into 21 provinces (Fig. 1), comprising counties, called soums. Agricultural production accounts for 21.7% of the gross domestic product, with livestock production constituting 84.7% of the total agricultural output (6). In this regard, animal husbandry plays a vital role in

Mongolia's social and economic development. In 2005, 30.6 million head of livestock were raised. These included 13.3 million goats, 12.9 million sheep, 2 million horses, 2 million cattle, 254,200 camels, 22,700 pigs and 141,700 chickens (6).

As of 2005, there were a total of 611,000 households in Mongolia; 37% of these were either households of herdsmen or owners of private livestock (6). All of these families with livestock have an average of one to three guard dogs. In cities, Mongolians live either in apartments, houses, or the traditional transportable dwelling, which is called a 'ger'. The people who live in gers and houses in cities also keep guard dogs. In addition to these working animals, the number of pet dogs has been recently increasing in cities. The companion animals and guard



**Fig. 1**  
**Spread of animal rabies in Mongolia between the end of the 1950s and the 1960s**

dogs are counted only in Ulaanbaatar, the capital city, which comprises 35% of the total households in Mongolia (6). As of 2007, 51,214 dogs and 803 cats were registered in Ulaanbaatar (7).

Research and epidemiological surveillance of animal diseases are extremely limited in Mongolia because of the lack of financial capacity. Furthermore, the epidemiological situation of infectious animal diseases in Mongolia has rarely been reported in international peer-reviewed journals, which is an impediment to the would-be researchers.

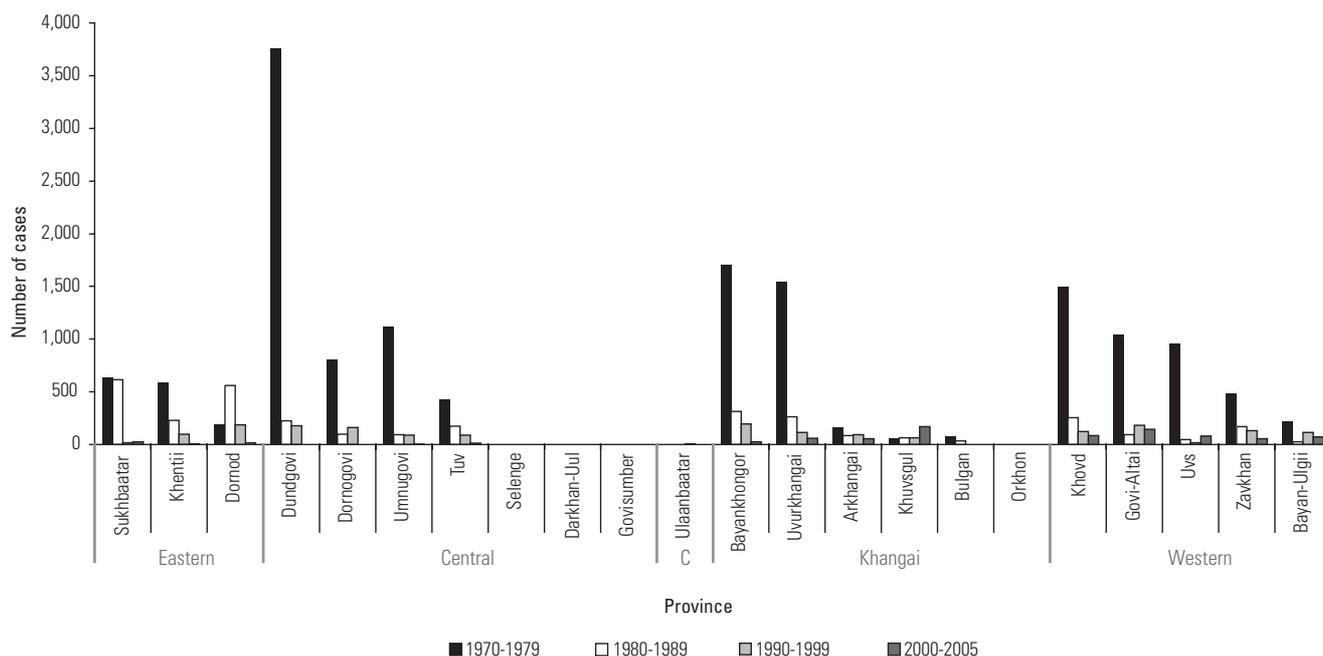
This paper describes the epidemiology of rabies in animals in Mongolia, its diagnostics, the nature and severity of the disease it produces in humans, and control measures to support the further development of a national control strategy against this disease.

## Rabies in animals

Official information about animal rabies in Mongolia before the end of the 1950s is not available. At the end of the 1950s, only a few cases of rabies were registered in the eastern soums of Sukhbaatar Province (4). By 1960 rabies

had spread to not only other soums of Sukhbaatar Province, but also to Dornod, Dornogovi, Khentii, Tuv, Dundgovi and Bulgan, the eastern, central and Khangai provinces. By 1965 rabies had caused deaths in 2,175 domestic animals, and 232 dogs and wild carnivores in these provinces. With the help of appropriate measures to combat this disease, including registration of guard dogs, killing of stray dogs, hunting of reservoir animals, vaccination of domestic animals and public education, the prevalence of rabies decreased in those provinces. But from 1966 rabies moved to the west, covering Dundgovi, Bulgan, Uvurkhangai, Arkhangai and Bayankhongor, the central and Khangai provinces. It occurred especially in foxes (*Vulpes vulpes*) and corsac foxes (*Vulpes corsac*). From 1968 onwards rabies outbreaks were reported in Bayan-Ulgii, Khovd and Govi-Altai, the western provinces, where no rabies had been reported for the previous 20 to 30 years. In 1970 rabies re-emerged from Dornod, Sukhbaatar and Khentii, the eastern provinces. From the above pattern of rabies distribution between the end of the 1950s and the 1970s, it can be seen that the disease emerged in the eastern provinces, moved to the west (Fig. 1) and again re-emerged from the eastern provinces.

Between 1970 and 2005, 21,302 rabies cases were reported in livestock: 40.9% were in cattle, 27.2% in



C: capital city

**Fig. 2**

**Rabies cases in livestock (cattle, camels, sheep, goats, horses) in provinces of Mongolia, 1970 to 2005**

camels, 17% in sheep, 12.1% in goats and 2.9% in horses (11). Out of the above-mentioned cases, 71.7% occurred between 1970 and 1979. Rabies was extremely prevalent in Dundgovi Province during this period (Fig. 2). Even though the reasons for this peak decade were never identified, one of the possible causes might be an increase of wild rodents, which might have led to the increase of carnivores, which are reservoirs of the rabies virus.

On 17 November 1972, the Ministers' Committee of the People's Republic of Mongolia approved Order No. 455 to 'Temporarily forbid the hunting of foxes and corsac foxes' in order to eliminate wild mice (4). But on 25 December 1974, the Ministry of Industry permitted the hunting of foxes and corsac foxes within the circle of the infectious foci of rabies to combat the high prevalence of the disease.

The sharp decrease in the prevalence of animal rabies from the 1980s onwards might indicate that the measures to decrease the number of infective wild reservoirs and improve appropriate veterinary measures were effective. However, between 2000 and 2005 this disease re-emerged, mostly in the Khangai and western provinces, with the peak prevalence in Khuvsgul Province (Fig. 2 and Fig. 3).

Between 1996 and 2005, a total of 1,311 rabies cases were registered in livestock and dogs, 25.4% of which occurred in 2001 (Fig. 4) when Govi-Altai, Khovd, Uvs and Bayan-Ulgii, the western provinces, had the highest prevalence (11). During the 10 years between 1996 and 2005, most rabies cases were reported in March (30.9%) and June

(17.5%) in both livestock and dogs (Fig. 5). Given that the latent period of rabies is just a few months, this indicates that most infections between animals usually occurred from winter to early spring. This period coincides with the mating period of wild carnivores (1). Out of the total of 31 cases in wild animals, reported in the database of the State Veterinary Department (SVD) between 1996 and 2005, the peak prevalence occurred in March (41.9%) and May (25.8%) (11).

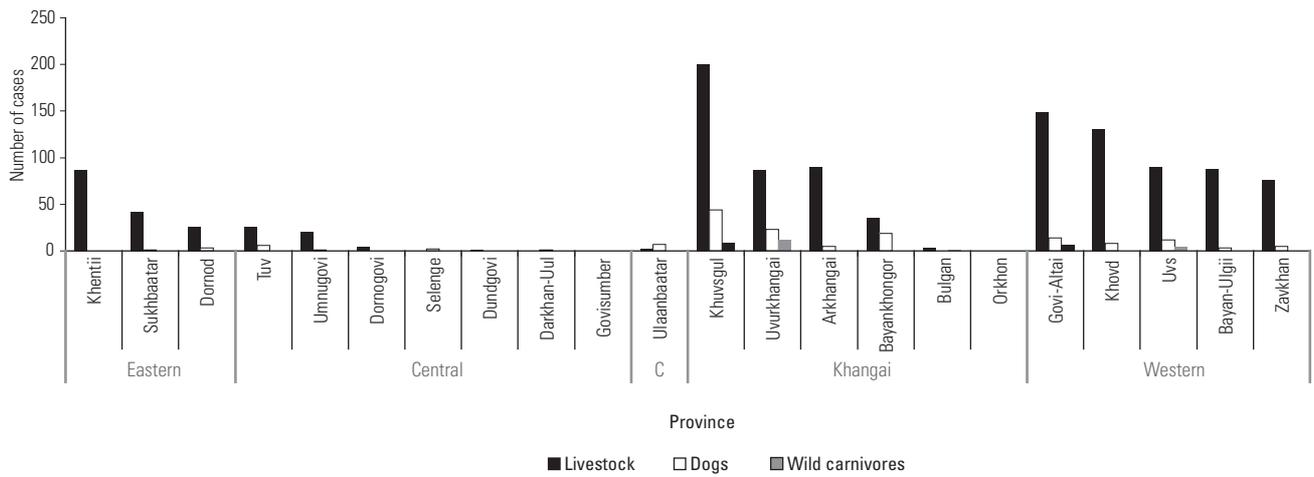
## Rabies in humans

Human rabies cases have been officially registered in Mongolia since the 1930s after the establishment of the Institute for Sanitation and Bacteriology. Between 1935 and 1941 a total of 909 people were vaccinated at the Institute, 91% of which had been bitten by dogs. Information is not complete, but according to what is reported, six people died during this period (2).

The authors could not find complete information for human rabies in the 1940s, 1950s and 1960s.

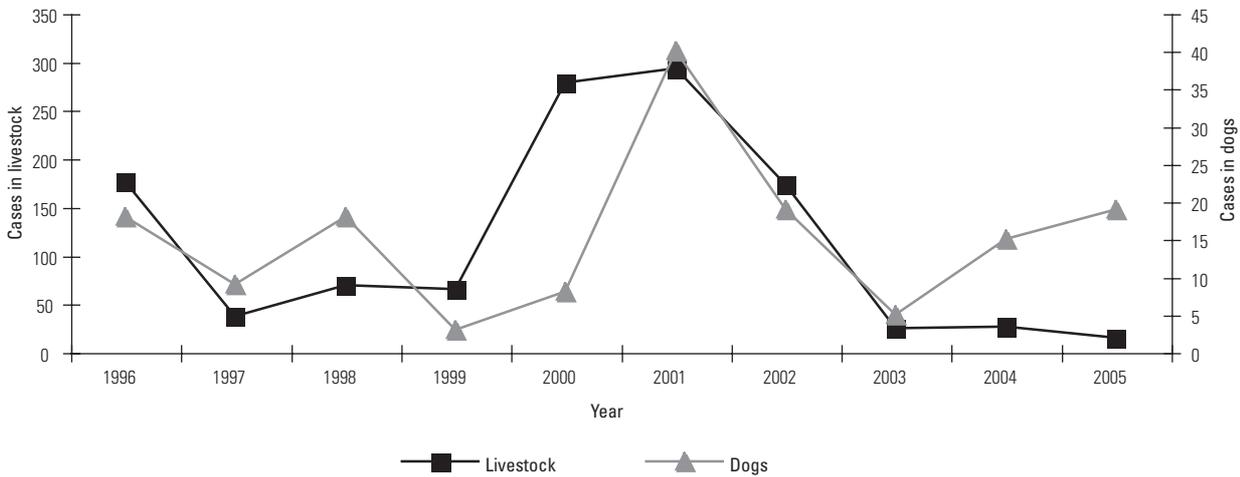
Between 1970 and 2005, 34 human rabies cases were reported (Fig. 6) (5). Eighteen (52.9%) of these patients were over 16 years old, and 20 (58.8%) were males. Nine (26.5%) cases occurred in herders.

Out of the 16 cases in children, 10 (62.5%) occurred in children under eight years old. Thirteen (81.3%) of the children were boys.

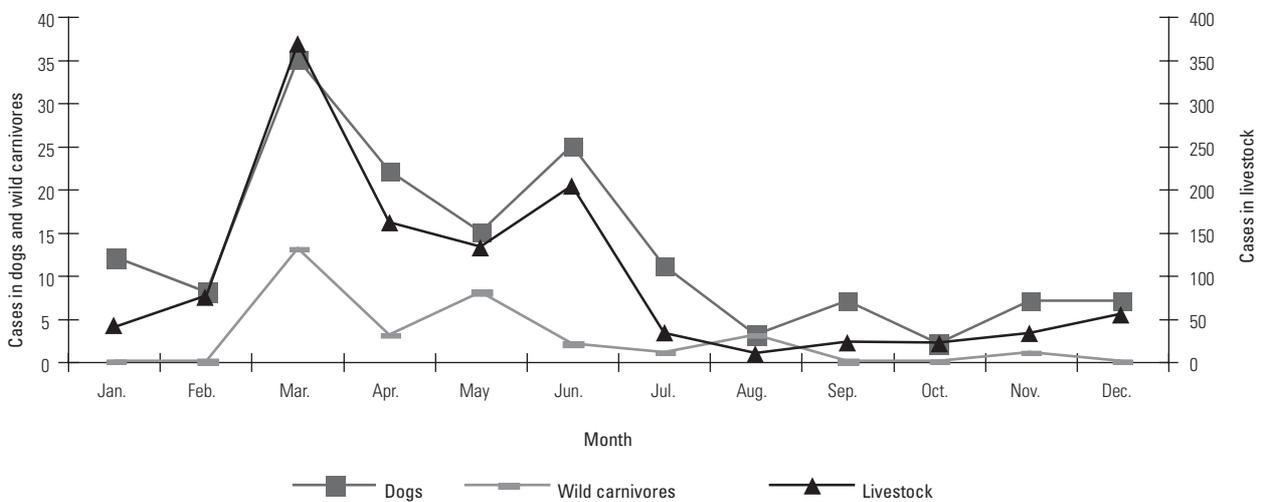


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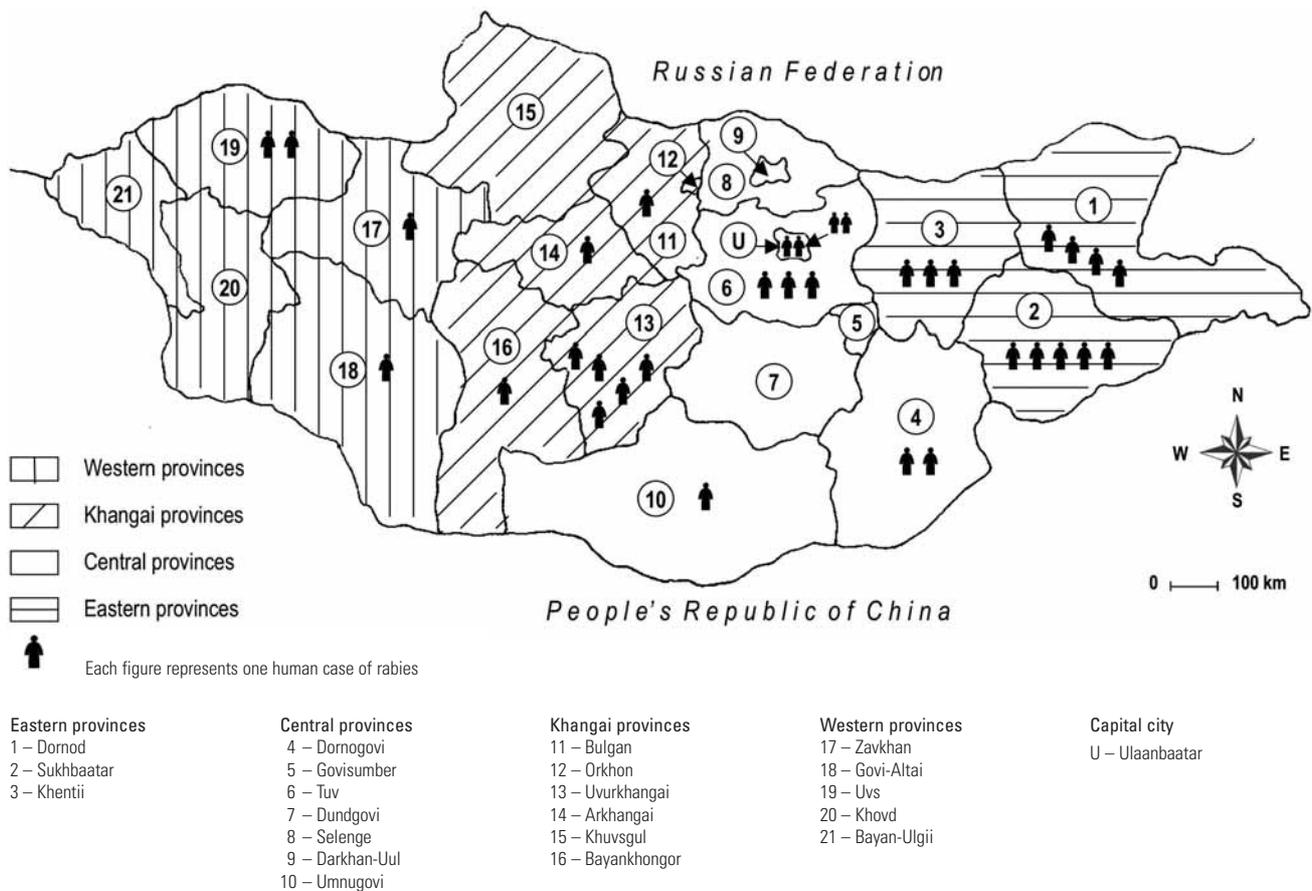
**Fig. 3**  
Rabies cases in livestock (cattle, camels, sheep, goats, horses), dogs and wild carnivores in provinces of Mongolia, 1996 to 2005



**Fig. 4**  
Rabies cases in livestock (cattle, camels, sheep, goats, horses) and dogs in Mongolia, 1996 to 2005



**Fig. 5**  
Rabies cases in livestock (cattle, camels, sheep, goats, horses), dogs and wild carnivores in Mongolia by month, 1996 to 2005



**Fig. 6**  
**Distribution of the thirty-four human rabies cases that occurred in Mongolia between 1970 and 2005, by region and province**

In fifteen (44.1%) of the human cases the source of the infection was dogs. A further seven (20.6%) human patients were infected by wolves (*Canis lupus*) and three (8.8%) by foxes. The sources of the other infections were not identified.

Between 2001 and 2005, a total of 647 people were vaccinated against rabies in Khuvsgul Province, where animal rabies had been prevailing. Of those 647 people, 174 (26.9%) were partially vaccinated. Out of the total number of people vaccinated 397 (61.4%) were living in the provincial centre and the rest in rural areas. Five hundred and fifty-five (85.8%) people were bitten by dogs, 507 of which were guard dogs or pet dogs (3).

Most cases of human rabies were reported in spring and summer (12).

## Transmission of infection

The co-existence of wildlife and livestock populations in Mongolia provides conditions that are favourable for the

transmission of disease agents. The fox, corsac fox, wolf and manul (*Felis manul*) are considered to be the indigenous sources of rabies infection for domestic animals in Mongolia.

### Fox

Foxes are widespread throughout Mongolia from the most northern taiga up to the desert. They are prevalent in the forest-steppe and steppe regions. In the plain steppe, the fox population increases tremendously and then decreases sharply depending on the number of wild rodents present (1).

### Corsac fox

Corsac foxes are common in the steppe areas. Most of them are found in the plain steppe areas in the eastern and central provinces, and they are less numerous in the mountainous steppe and semi-desert areas. They do not exist in the taiga and desert. The corsac fox population is unstable (1).

## Wolf

Wolves are spread throughout Mongolia. Most live in the forest-steppe and steppe areas in the eastern and central provinces, and a few can also be found in the desert and taiga (1).

## Manul

The manul is famous as an inhabitant of the Mongolian steppe, especially of the eastern region. This animal is also found around Lake Khuvsgul. Manuls live in the lower areas of mountainous steppe, and semi-desert, but not in the forest and desert (1).

Perenlei (8) identified the roles of carnivores in the transmission of rabies, using different sources: his own observations, the observations of veterinarians and herders, and the database of the SVD. Wild animal rabies has been reported and recorded in the database of the SVD since 1965. From 1961 to 1969, among the total number of rabid carnivores observed by Perenlei, foxes comprised 74.2%, corsac foxes and manuls 15.3%, dogs 6.9%, and wolves 3.6%. During this period, the wolf was the most significant source of rabies infection for other animals. They were the source of infection of 73.1% of rabid small ruminants, 12.6% of rabid horses, 8.3% of rabid camels, 4.9% of rabid cattle and 32.4% of rabid dogs. During this period, 13 cattle and two small ruminants were infected by foxes and corsac foxes. During his research, Perenlei did not observe any rabies infection from dogs to other domestic animals. He explained that herders observed their dogs closely and killed them if there was any suspicion of rabies.

From 1965 to 1969, Perenlei studied the seasonal prevalence of rabies in dogs and wild carnivores using the data from the steppe provinces (Sukhbaatar, Dornod, Tuv and Dundgovi) and high mountainous provinces (Bayan-Ulgii, Khovd, Govi-Altai). In the steppe provinces, dogs showed symptoms of rabies from October to May, wolves from September to May, foxes from July to March and corsac foxes from August to April, with peaks in December. In the high mountainous provinces, rabies in dogs occurred from January to July, in wolves from August to June, in foxes from October to May, and in manuls and corsac foxes from September to July. In the natural foci of rabies, the disease occurred in domestic animals between 23 days and two months after outbreaks had occurred in foxes and corsac foxes.

## Diagnosis

Today, the State Central Veterinary Laboratory (SCVL) diagnoses rabies cases by smear staining and immunofluorescence methods (10). Since 2004, twelve

provincial laboratories have been equipped and are capable of conducting the same diagnostic tests. The remaining nine provinces send samples to the SCVL for diagnosis. Between 1996 and 2005, out of 419 suspected rabies samples that arrived at the SCVL, 191 (45.6%) were positive. Sixty-nine samples were positive in cattle, followed by 52 in dogs, 19 in foxes, 18 in wolves, 11 in goats, 9 in horses, 7 in camels and 6 in sheep. Out of the total number of samples from foxes, 82.6% were positive, followed by 64.7% in goats, 60.5% in dogs, 42.3% in cattle, 38.9% in camels, 32.1% in horses, 31.6% in wolves and 28.6% in sheep.

It is interesting to note the figure for wolf samples, as wolf brain is used for traditional healing in Mongolia. Between 2004 and 2007, rabies virus was detected at the SCVL in six (8.8%) samples from 68 wolf brains that were received from people wanting to know whether they could be used for human treatment.

## Control measures

In Mongolia, rabies epidemiological surveillance is limited to the data submitted from local veterinarians and laboratories.

The Law on Hunting in Mongolia, approved in 2000, regulates animal hunting and trapping, and the appropriate use of hunting reserves. Within a certain period of each year, animal hunting for production and private purposes is permitted, but must not exceed the limit established by the local parliament. The number of animals that can be hunted for a special purpose is established by the Government. According to Article 13.1 of the Law, foxes and corsac foxes can be hunted from 21 October until 16 February. Hunting periods for other animals, not described in the above article, are established by the State Administrative Central Organization responsible for Nature. If animals are hunted to combat infectious disease foci, the recommended hunting periods set down by the Law can be disregarded. According to Article 6.1 of the Law on Hunting Reserve Use Payments, and Hunting and Trapping Authorization Fees, approved in 1995, the payments and fees for hunting wolves are waived if the purpose is to protect livestock and reduce the population density of wolves in a certain area.

The disease control measures implemented in stray dogs consist of a cull each year in the cool season (November to January). The exact number of stray dogs in Mongolia is unavailable (even guard dogs in urban areas are allowed to wander).

In most countries, the vaccination of all domestic livestock against rabies is difficult to justify (there are few economic

or public health benefits) (13). But in Mongolia, where traditional pastoral animal husbandry exists and livestock have easy contact with wildlife, vaccination is the only effective way of preventing this disease in the infectious foci. Even though animal husbandry and veterinary services were privatised in the 1990s, the State has been continuing to cover the cost of preventive measures against infectious animal diseases, including vaccines and vaccination services. The primary swine kidney cell-culture, freeze-dried, attenuated vaccine of the ERA (Evelyn Rokitniki Abelseth) strain has been produced for domestic animals at Biocombinat, the state-owned manufacturer of veterinary biologicals, since 1981 (9). Unfortunately, the coverage of urban dogs in the vaccination campaign is not satisfactory. In 2007, out of the total of 51,214 pet dogs and guard dogs in Ulaanbaatar, only 9,104 (17.8%) were vaccinated against rabies (7). Immunisation of wild carnivores is not practised at all.

Prophylaxis prior to exposure is almost never practised in Mongolia. Rabies post-exposure prophylaxis (PEP) for humans consists of the appropriate administration of human rabies immune globulin (HRIG) and rabies vaccine. In Mongolia, the caprine nerve-tissue vaccine using the Pasteur strain has been produced for human use since 1956 (2) at the Biotechnology Production and Research Center of the Public Health Institute. The vaccine Rabivac-Vnukovo-32 (Microgen, Russian Federation) and HRIG (Microgen, Russian Federation) are imported.

## Discussion

Scientific research on rabies is extremely limited in Mongolia. Consequently, there are still many unanswered questions as to why the disease prevalence varies in different areas, why it migrates from area to area, and how future control programmes should be developed.

Because nomadic pastoral animal husbandry is practised in Mongolia avoiding contact with wild carnivores is difficult. Even though hunting wolves is supported by the State, in the infectious rabies foci, close cooperation between veterinarians and clinicians, along with the governmental stakeholders, is imperative in the planning of hunting, especially of foxes and corsac foxes.

In most places, the culling of stray dogs is carried out seasonally. But it is important to have permanent staff who are responsible for controlling the stray dog population throughout the year in each administrative unit.

The animals that most frequently attack humans in Mongolia are guard dogs. It is important, therefore, that the vaccination programme for these animals be improved. Unfortunately, most of the urban dogs are left out of the vaccination campaign. The human vaccination requires several doses a few days apart and because of this inconvenience, many people stop taking the vaccination after only a few injections. If the vaccination of dogs was carried out effectively and their health status was definitely known, clinicians would be able to decide whether the human PEP was really necessary for someone attacked by a dog.

Probably because of the lack of knowledge of zoonotic diseases, people ignore the importance of not allowing their dogs to wander freely. Thus, the provision of public education about zoonoses for both adults and children should be a priority in Mongolia.

The exchange of information about zoonoses between veterinary and public health departments is the key to combating diseases, but it is unsatisfactory in Mongolia. A central coordinating body or mechanism should be established to ensure that the efforts to control rabies are cohesive and produce satisfactory results (14).

## Acknowledgements

We would like to express our thanks to S. Divangar, Ministry for Food, Agriculture and Light Industry, Mongolia, Dr Ts. Purevkhoo, State Veterinary and Breeding Agency, and Dr D. Dandii, Public Health Institute, for supplying valuable information for this report. We would also like to thank Anne Thomas in Sendai, Japan, for editorial assistance.



## Rage animale et humaine en Mongolie

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### Résumé

En Mongolie, la prévalence de la rage animale varie d'une région à l'autre. Le loup (*Canis lupus* Linnaeus, 1758), le renard roux (*Vulpes vulpes* Linnaeus, 1758), le renard corsac (*Vulpes corsac* Linnaeus, 1768) et le chat de Pallas ou manul (*Felis manul* Pallas, 1778) constituent les réservoirs sauvages du virus dans la nature. Parmi les animaux domestiques, les espèces affectées sont d'abord les bovins, suivis des chameaux, des ovins, des chèvres et des chevaux. Un pic de prévalence de la rage animale a été enregistré dans les années 1970. L'incidence la plus élevée pendant cette même période a été relevée dans la province de Dundgovi. Le nombre de cas de rage animale a décliné au cours des années 1980. Ce déclin s'explique probablement par la diminution du nombre d'animaux sauvages faisant office de réservoirs et par la mise en œuvre de mesures sanitaires appropriées. Des cas de rage animale ont été enregistrés ces dernières années dans les provinces occidentales et dans celles du Khangai. Le chien est la cause la plus fréquente de l'infection chez l'homme. Les programmes de vaccination des chiens doivent être améliorés afin de minimiser l'incidence de la rage humaine. Les auteurs décrivent l'épizootiologie et l'épidémiologie de la rage animale et humaine en Mongolie. Ils décrivent également les programmes de lutte mis en œuvre en Mongolie pour contrôler cette maladie.

### Mots-clés

Chat de Pallas – Diagnostic – Épidémiologie – Épizootiologie – Loup – Mongolie – Pastoralisme nomade – Rage – Renard – Renard corsac – Vaccination – Zoonose.



## Rabia humana y animal en Mongolia

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### Resumen

En Mongolia, la prevalencia de la rabia en animales difiere según la zona de que se trate. Por lo que respecta a los focos naturales, se considera que los animales salvajes infecciosos son el lobo (*Canis lupus* Linneo, 1758), el zorro (*Vulpes vulpes* Linneo, 1758), el zorro corsac (*Vulpes corsac* Linneo, 1768) y el manul (*Felis manul* Pallas, 1778). En cuanto a los animales domésticos, los más afectados por la enfermedad han sido los bovinos, seguidos de los camélidos, ovinos, caprinos y équidos. El pico de prevalencia de rabia animal se registró en los años setenta, periodo durante el cual la mayor incidencia se dio en la provincia de Dundgovi. En el siguiente decenio se redujo el número de casos de rabia en animales, debido quizá a la retracción de los reservorios salvajes y a la aplicación de medidas veterinarias más eficaces. En los últimos años la rabia animal se ha manifestado sobre todo en las provincias de Khangai y de la parte occidental del país. En cuanto a la rabia humana, la fuente de infección es casi siempre el perro. De ahí que para reducir al mínimo la incidencia de la rabia en

el hombre sea indispensable mejorar los programas de vacunación canina. Los autores describen la epizootiología y epidemiología de la rabia animal y humana en Mongolia, así como los programas de control, incluido el diagnóstico, instaurados en Mongolia con el fin de atajar la enfermedad.

**Palabras clave**

Diagnóstico – Epidemiología – Epizootiología – Lobo – Manul – Mongolia – Rabia – Rebaños nómadas – Vacunación – Zoonosis – Zorro – Zorro corsac.



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