

Report on a consultancy conducted on behalf of the Wildlife Conservation Society  
on:

**CURRENT DISEASE CONTROL POLICIES AND 'KNOWLEDGE GAPS' IN  
THE EPIDEMIOLOGY OF FOOT AND MOUTH DISEASE ON MONGOLIA'S  
EASTERN STEPPE**



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## Executive summary

At least 4 new foot and mouth disease (FMDV) introductions occurred in Mongolia between 2000 and 2010; 3 belonging to serotype O and a single Asia 1 introduction. These introductions were part of Asian pandemics/epidemics that affected many countries without the agency of wildlife.

It is possible that Mongolian gazelles were responsible for introduction of one of the 7 FMD outbreaks that occurred between 2000 and 2010, i.e. the evidence is that the other 6 outbreaks were introduced by other means. However, there is no indication that any of these viral incursions persisted in Mongolia, either in livestock or Mongolian gazelles.

The FMD outbreak in eastern Mongolia that began in April 2010 was resolved in December 2010 and so Mongolia is currently free from FMD. Country-wide surveillance conducted in 2007 proved that FMD was not endemic in livestock populations throughout Mongolia. Less extensive and intermittent studies conducted on Mongolian gazelles since 1998/9 provides support for a similar conclusion in relation to gazelles on the eastern steppe.

Outbreaks of FMD in Mongolia over the last 11 years □ all but two of which occurred on the eastern steppe □ have clearly demonstrated that the livestock and wildlife of the eastern grasslands are at high risk of contracting FMD. Therefore, until the cross-border risk of FMD introduction declines significantly, Mongolia will need to institute measures to better protect its borders against FMD penetration and also ensure that on occasions when the infection breaches the perimeter defenses, the impact is limited.

Because of the FMD threat posed to livestock and gazelles on the eastern steppe it would be prudent for Mongolia to implement systematic, routine vaccination of livestock to ensure that adequate levels of herd immunity are maintained against FMD viruses current in south-east Asia. To ensure efficacy, such programs need to be regularly audited. If that is done, even if gazelles became infected, they would be incapable of spreading FMD to livestock.

One of the problems associated with the 2010 outbreak of FMD in Mongolia was that at least one of the vaccines used to manage the outbreak contained a serotype O vaccine strain that was poorly matched with the outbreak viruses. To obviate recurrence of this event recommendations on how the Veterinary and Animal Breeding Agency (VABA) could better manage the problem in future are provided.

Although the VABA has effectively managed FMD outbreaks in the past, some of the practices employed in outbreak management are questionable. This report argues that 'modified stamping out (MSO)', whereby diseased livestock and wildlife are destroyed but not other animals in the herd, is inconsistent with current understanding of the epidemiology of FMD. It is therefore recommended that this practice be reviewed, particularly in regard to wildlife. Likewise some of the actions aimed at disinfection conducted during recent outbreaks are of doubtful value and have the disadvantage of being environmentally damaging. These also should therefore be reviewed. It is suggested that management of FMD outbreaks could be considerably simplified and rendered less expensive by abandoning MSO and modifying present disinfection procedures.

Some serious misunderstandings in relation to the epidemiology of FMD □ and on which control actions were based in Mongolia in 2010 □ were identified during this consultancy. It appears that this was to some extent due to people in senior administrative positions taking decisions without adequate technical understanding or advice. This issue requires attention if the deficiencies that occurred in 2010 are not to be repeated.

For effective FMD management in Mongolia all the above issues need to be incorporated into an overall strategy supporting policy consistent with Mongolia's future rural development plans. In this respect the plan to establish a FMD-free zone in the west of the country to enable future meat exports to external markets needs to be better integrated with an up-dated FMD management approach along the lines recommended in this document.

## **1. Abbreviations**

ARRIAH – All Russian Research Institute for Animal Health

DAPIA - Dornod Aimag Professional Inspection Agency

FAO – Food & Agriculture Organisation of the UN

FMD – foot and mouth disease

FMDV – foot and mouth disease virus

IAH – Institute for Animal Health, Pirbright Laboratory, UK

MSO – modified stamping out

NEC – National Emergency Committee

NEMA - National Emergency Management Agency

OIE – World Organization for Animal Health

SEA – South-East Asia

SCVL – State Central Veterinary Laboratory, Ulaanbaatar

SPS – sanitary and phytosanitary

ToRs – terms of reference

VABA – Veterinary & Animal Breeding Agency (Ministry of Food Agriculture & Light Industry)

UK – United Kingdom

VP1 – viral protein 1

## 2. Introduction

The consultancy described in this report was intended to address the reasons for the on-going transmission of foot and mouth disease (FMD) on the grasslands of Mongolia's eastern steppe over the last 11 years and, in particular, the role of Mongolian gazelle in the outbreaks that occurred there. It was also intended that the consultancy would provide recommendations for future disease management policies and research priorities to fill knowledge gaps regarding FMD in Mongolia.

Full terms of reference and the activities undertaken during the consultancy are shown in Appendices A and B. People consulted are listed in Appendix C. The agenda, participants and power point presentations made during the consultative workshop held in Ulaanbaatar on 31 January 2011 are reproduced in Appendices D.

Between 2000 and 2010 Mongolia suffered 7 outbreaks of FMD. Prior to 2000 Mongolia had been free from FMD for a period of 25 years although in the more distant past the disease had been present in the country intermittently, i.e. over the periods 1931-1935, 1941-1948 and 1963-1974 (Purevkhuu: Appendix D). The FMD outbreaks over the last 11 years have proven disruptive of animal production in the east of the country and have hampered Mongolia's intention to maintain and expand access to international markets for livestock commodities and products, meat particularly. It is consequently a Mongolian priority to develop more effective measures for the management of FMD and consideration is currently being given to establishment of a FMD-free zone where vaccination against FMD is not practiced in the west of the country to enable livestock-associated exports.

A particular question surrounds the possible role of Mongolian gazelles (*Procapra gutturosa*) in the introduction and spread of FMD outbreaks on the eastern steppe of the country. This species is known to be susceptible to FMD and therefore could potentially introduce FMD as a result of migration across Mongolia's borders with China and Russia and also contribute to the spread of FMD within the country once outbreaks occur. The range and density of the Mongolian gazelle population has declined greatly in recent times and there is little doubt that the population is, and for some years has, been in decline (Olsen, 2007). More effective conservation of this species is therefore an obvious priority for conservationists.

The involvement of Mongolian gazelles in the recent occurrence of FMD in Mongolia has become a subject of dispute, mainly between livestock production/trade interests and conservation bodies. Unfortunately, much of this debate has suffered from the disadvantage that a sound technical understanding of the relative susceptibility, rates and duration of FMD viral (FMDV) excretion and the ability of Mongolian gazelle populations to maintain FMDV independently of other species is lacking. This report attempts to cast this debate in the context of what is currently understood about FMD and its behavior in wildlife situations and suggest measures that could be considered in the immediate future for better management of prevention and control of FMD as well as lines of investigation to narrow present knowledge gaps.

The issue of wildlife/livestock interaction in respect of FMD in Mongolia has, in this investigation, been considered broadly because livestock/wildlife interaction impacts upon and, in turn, is influenced by a variety of land-use factors and practices, including trade in livestock commodities and products and future intentions in that regard.

### 3. Features of Mongolia's eastern steppe grassland salient to FMD

Coexistence between nomadic herders and their livestock and large numbers of wildlife, especially Mongolian gazelles, was a feature of the eastern steppe for hundreds of years. In more modern times this relationship has changed due to population growth among herders and their livestock and a decrease in the distribution and numbers of gazelles.

The climate of eastern Mongolia is characterized by long harsh winters with frequent temperature inversion and short summers when the little precipitation that occurs tends to fall, i.e. the eastern grasslands are semi-arid and subject to periodic drought (Sternberg *et al.*, 2010). Average annual rainfall is around 260 mm/year.

The distribution of Mongolian gazelles on the eastern steppe currently covers an area only about 25-30% the size of their original distribution, i.e. in the region of 190 000 km<sup>2</sup>, more than 90% of which is within Mongolian territory (Wingard & Zahler, 2006; Nyamsuren *et al.*, 2006). Their numbers likewise have declined from, possibly, 18 million to between 1 and 5.5 million (Wingard & Zahler, 2006; Olson, 2007). Most of the other wild large herbivores that historically were sympatric with these gazelles are greatly reduced in number or are no longer present, *viz.* red- and roe deer (*Cervus elaphus* & *Capreolus pygarris*), argali (*Ovis ammon*), Przewalski's horse (*Equus ferus przewalski*) and khulan (*Equus hemionus*) (Olson, 2007).

Due to population growth of pastoralists, livestock (horses, cattle, sheep, goats and camels) numbers are apparently increasing although the rate is difficult to ascertain. Perhaps in the region of 8 million head of livestock occupy the eastern grasslands, the majority being sheep and goats with cattle numbering less than horses (extrapolated from livestock data provided by the Veterinary and Animal Breeding Agency [VABA], Ministry of Food, Agriculture and Light Industry [MoFALI]). Livestock are therefore more numerous than wildlife on the eastern steppe of Mongolia.

An account of the dynamics of the livestock sector in Mongolia since the collapse of the socialist system in 1990 has been provided by a World Bank study ([http://siteresources.worldbank.org/INTMONGOLIA/Resources/report\\_Eng.pdf](http://siteresources.worldbank.org/INTMONGOLIA/Resources/report_Eng.pdf)). In that report the decline of 'marginal' herders with less than 100 animals and concomitant increase of those with larger herds is documented. The report shows that herders are less nomadic than is often presumed. There has been a steady increase in the number of goats relative to sheep over the last decade, at least one reason being the increasing value of Cashmere. A recent newspaper report indicates that at the end of 2010 the price of mutton in Mongolia increased by about 30% as result of both severe weather and the 2010 FMD outbreak (<http://www.washingtontimes.com/news/2011/feb/15/rising-global-food-costs-an-extreme-poverty-crisis/>).

Mongolian gazelles are herd animals with extraordinary migratory tendencies; a study based on 10 radio-collared individuals showed that the 10 animals ranged over an area of 80 000 km<sup>2</sup>; a large population would logically need much more territory (Olson 2007). Furthermore, the movement patterns of gazelle are so far unpredictable although unsurprisingly they seem to congregate in areas where grazing is good (not necessarily areas with the highest biomass). For these reasons

the interactions between gazelles and livestock are to a large extent unpredictable although it is a general observation that gazelles tend to avoid areas within 15 km of villages and towns (Olsen, 2007). This is unsurprising because gazelles have been hunted at unsustainable levels for decades (Zahler et al., 2003; Wingard & Zahler, 2006). It has also been observed that gazelles graze more readily in the vicinity of sheep and goats than cattle (Olsen, 2007).

The nomadic herders, although they tend to remain in the same general area or soum, also move their herds to where the best grazing and water are to be had. This includes areas □ unfenced □ that have been designated for the protection of gazelles although the numbers of herders authorized to graze those areas are apparently limited. There is also some debate as to whether the protected areas are most suited to maintenance of gazelle population health (Olsen, 2007).

The border between the eastern steppe of Mongolia and China is double-fenced along most of its length (but not where the terrain is unsuitable), each country being responsible for the erection and maintenance of its fence. Both fence lines are about 1.5 m high<sup>1</sup> and use at least some barbed wire. The distance between the fences is approximately 500 meters and gazelles are known sometimes to graze in this effective no-man's-land. It is reported by Mongolian authorities that the Chinese fence is in a good state of repair and better in that respect than the Mongolian fence. It was also stated by Mongolian officials stationed in this border area that occasionally gazelles enter Chinese territory from Mongolia □ perhaps encouraged by Chinese border guards who leave gates in their fence open □ but that few if any return.

A confidential report by the VABA indicates that the north-west winter wind sometimes drives Mongolian livestock towards the Chinese border where snow-drifts may enable them to cross the fence lines. Whether these livestock are returned or not was not reported but presumably that is the case. Border officials also stated that occasionally Chinese livestock wander into Mongolian territory; these are rounded up and returned to Chinese representatives. There is, furthermore, a rumor that a small amount of unofficial trade, mostly in breeding livestock, occurs across the border because people living along this divide between Inner and Outer Mongolia have traditional and ethnic affiliations. It is obviously difficult to decide how much credence to apportion to these 'stories' especially since by Mongolian law it is apparently illegal to perform any commercial activity within 15 km of the border.

Along the Mongolia/Russia border, it was reported, there is only a fence east of the Choibalsan-Borzya railway line, the border to the west of the railway line being unfenced. It is known that a small number of gazelles sometimes migrate across the border between Dornod Aimag and Russia (see below). Reportedly little or no other movement of animals occurs across this border.

Perhaps though, the greatest FMD risk to Mongolia from China is posed by official crossing points where trucks transporting fresh horticultural products enter Mongolia. These products probably pose little direct risk of FMD to Mongolian livestock but the possibility is that trucks that have previously been used to transport livestock in China will be used to transport vegetables without first being cleansed. Such

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<sup>1</sup> Close inspection of these fences was not possible because of Mongolian border policy; however, a portion of the border was viewed from a distance and one border crossing was visited

vehicles, once they have entered Mongolia, could be used to transport of livestock within Mongolia. At border crossings only the wheels of trucks are disinfected □ a practice of limited value.

From the above it is apparent that management of movement of animals and animal products across eastern Mongolia's borders is good but it is equally obvious that some trans-border movement of livestock and gazelles occurs. The increasing trade, especially in horticultural products, with China also poses some risk even when legitimate.

Livestock values are reportedly higher in China than in Mongolia, so the incentive to illegally import animal commodities into Mongolia is small.

#### **4. FMD outbreaks in Mongolia: 2000 to 2010**

During this period Mongolia suffered 7 outbreaks of FMD □ the salient features of each are summarized in Table 1. Their location and spread of individual outbreaks are shown in Fig. 1.

Collective consideration of the features of these 7 outbreaks permits the following broad conclusions to be drawn:

- Serotype O has been predominantly involved; only one outbreak was caused by serotype Asia 1.
- Five of the 7 outbreaks were first detected in the proximity of the Chinese border in eastern Mongolia (Fig. 1).
- Of the 5 outbreaks that occurred in areas where Mongolian gazelles are prevalent, 3 infected gazelles (see below).
- In only 3 of the 7 outbreaks did the infection spread significantly, *viz.* the outbreaks of 2001, 2004 and 2010: However, it is possible the 2001 outbreak was an extension of that of 2000 because although the initial foci were separated by some distance (Fig. 1), the viruses isolated from these outbreaks were shown to be closely related on the basis of genome sequence (Fig. 3). Alternatively there could have been two introductions across the Chinese border of closely related viruses over the 3-4 month interval between the two 'outbreaks';
  - A similar situation may explain the two phases of the 2010 outbreak.
- Three of the outbreaks occurred in livestock said to have been vaccinated (2004, 2005 & 2010). How effectively the livestock populations involved were vaccinated is unknown (see below).

##### **4.1 Outbreak relationships based on genome sequencing of outbreak viruses**

The serotype O viruses that caused outbreaks in eastern Mongolia in 2000 and 2001 and in the west of the country in 2002 (Fig. 1) were extensions of the Pan-Asian O pandemic that originated in northern India in 1990 and subsequently spread into the rest of South Asia, South-east Asia, eastern Europe, the Middle East and even further afield causing major outbreaks in South Africa in 2000 and the UK in 2001 (Thomson & Bastos, 2004). These virus isolates, based on their nucleotide

sequences, belong within the ME-SA toptotype (Fig. 3). Related viruses are known to have occurred in China in 1999 (Qian Feng *et al.*, 2003). The question is whether these two apparently separate Mongolian outbreaks were separate introductions of the infection or whether the 2001 outbreak was simply an extension of the 2000 outbreak. In 2002 viruses within the same lineage were the cause of the isolated outbreak that occurred in the west of the country (Fig. 3). Importantly, however, there is no evidence that this group of viruses persisted in Mongolia after 2003.

In contrast to the 2000/1/2 outbreaks, the 2004 Mongolian outbreak was caused by viruses whose genome sequences placed them in the SEA toptotype of serotype O, i.e. a different lineage (Fig. 3). A Chinese isolate from 2003 was shown to have a close relationship with a 2004 Mongolian isolate (Fig. 2). The 2004 outbreak was therefore caused by a serotype O viral lineage novel to Mongolia.

A further new FMDV introduction of FMDV, i.e. Asia 1 virus, caused the 2005 outbreak. This was also an extension of an Asia-wide pandemic that began in China in 2005 (Valarcher *et al.*, 2009; Perez *et al.*, in press).

No sequence data are available for the viruses involved in the 2006 outbreak which occurred in livestock associated with a veterinary school teaching facility located outside the capital city, Ulaanbaatar. The outbreak is considered to have been a laboratory-generated anomaly.

In 2007 an extensive sero-survey among livestock, assisted by FAO, was conducted throughout Mongolia based on detection of antibodies to non-structural viral proteins<sup>2</sup> (NSPs). This survey identified two areas where sero-positive animals were present (i.e. the vast majority of the sampled areas had no sero-positive animals). One area was in Orkhon Aimag in the north-central part of the country and the other in an area extending between Sukhbaatar and Dornogobi Aimags in the south-east. Follow-up investigations in these two areas reportedly failed to detect any sign of FMD.

A number of viral isolates are available from the most recent (2010) FMD outbreak (possibly two related outbreaks) that was first recognized close to the Chinese border in Dornod Aimag in April 2010 (Fig. 2). This has enabled very useful molecular epidemiological information to be generated.

All the FMD viruses isolated from this outbreak were closely related (Fig. 2). The viruses, like those of 2004, grouped within the SEA toptotype but there were nevertheless significant sequence differences between the 2004 and 2010 outbreak viruses (Fig. 2). Consultation with viral geneticists at the FAO World Reference Laboratory in the UK supported the opinion that the 2010 O serotype isolate was representative of a new introduction and not evolution of the 2004 outbreak viruses in an endemic environment (N. Knowles & J. Bashiruddin, personal communication, February 2011). This is firm evidence that FMD has not been endemic in Mongolia over the last decade.

Viruses, among those for which sequences are available, most closely related to those of the Mongolia 2010 outbreak were from Malaysia and Taiwan in 2009 (Fig.

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<sup>2</sup> These tests are apt for detection of recent infection with FMDVs as long as the animals concerned were not vaccinated with vaccines contaminated with non-structural viral proteins, i.e. antibodies to NSPs are not induced by 'purified' vaccines

2). In February 2010 China reported the commencement of a serotype O outbreak which subsequently spread widely in that country over the course of 2010 (WAHID – [www.oie.int](http://www.oie.int)). In July 2010 Russia reported a serotype O outbreak adjacent to the Chinese border to the OIE and the wording of the report infers China as the source (WAHID –

[http://web.oie.int/wahis/public.php?page=single\\_report&pop=1&reportid=9524](http://web.oie.int/wahis/public.php?page=single_report&pop=1&reportid=9524)).

Sequence data obtained from an isolate made from the Russian outbreak (O/Rus/Aug2010 - supplied by the All Russian Research Institute for Animal Health [ARRIAH]), showed that on the basis of VP1<sup>3</sup> sequence it could not be differentiated from 2010 Mongolian viruses (Fig. 2). This is evidence for Mongolia's 2010 outbreak being derived from China and that the same virus spread to Russia. From Russia it could have been re-introduced to Mongolia (i.e. near the northern border of Dornod Aimag with Russia in the autumn of 2010 – see below).

The viruses associated with the autumn phase of the 2010 outbreak in Mongolia, diagnosed in August close to the Russian border with Dornod Aimag, were not significantly different from those of the spring phase (Fig. 2). However, because of the location and spread of the autumn phase of the 2010 outbreak, it is reasonable to assume that the second phase of this outbreak was introduced from Russia, that country having acquired the infection from China in July. Whether gazelles were the vehicle of re-introduction is a matter of conjecture; the only evidence is circumstantial.

#### 4.2 Involvement of gazelles in FMD outbreaks in Mongolia

In the 1960s an outbreak of FMD caused large-scale mortality among Mongolian gazelles (Sokolov & Lushchekina, 1997). Such incidents in gazelles and antelope are rare but have also been experienced in South Africa and Israel in impala (*Aepyceros melampus*) and Mountain gazelles (*Gazella gazella*) respectively (Shimshony, 1987; Thomson *et al.*, 2003).

More recently, based on case descriptions, photographs, serological studies and isolation of FMDVs from lesion material, there is no doubt that Mongolian gazelles have been involved in some FMD outbreaks. In 3/5 FMD outbreaks in eastern Mongolia over the last 11 years, *viz.* 2001, 2004 and 2010, gazelles were indisputably infected, but not in the outbreaks of 2000 and 2005 (Table 1). In 2001, although gazelles became infected they did not develop clinical signs of FMD or else the lesions were not severe enough to cause obvious signs such as lameness (Ulambayar, 2000).

In the 2004 outbreak, as already stated, it was observed that gazelles showed signs of FMD a month before the disease was detected in livestock (Sodnomdarjaa *et al.*, 2007) but in 2001 and 2010 the converse was the case.

Anecdotal evidence that the autumn phase of the 2010 outbreak could possibly have been introduced to Mongolia from Russia by gazelles returning across the border has been mentioned. It is difficult to attach particular significance to such speculation because in livestock diseases that may involve wildlife it frequently happens that investigations into outbreaks progress no further than identifying an occasion where

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<sup>3</sup> VP1 – The gene that codes for viral protein 1, i.e. a surface protein of FMDV that contains important antigenic sites

livestock and wildlife have been in the same vicinity; the transmission of the disease by wildlife is then presented as 'fact' (G R Thomson, personal observation).

In 1998/9, i.e. before the advent of the 2000 outbreak in Dornod Aimag, a broad study of infectious agents was conducted on 26 legally hunted gazelles (WCS, unpublished data). Unfortunately, the precise location(s) of where the hunting took place is not indicated but it is clearly on the eastern steppe. None of the gazelles tested had antibodies to FMDVs (serotypes A, O, Asia & C).

During the 2000 outbreak in Dornogobi, an investigation into the possible involvement of wildlife was undertaken and 19 Mongolian gazelles and 2 black-tailed gazelles (*Gazella subgutturosa*) were shot for examination. No lesions consistent with FMD were observed in the animals and serology (complement fixation) did not reveal the presence of antibody to FMDVs (Ulambayar, 2000). It was concluded from absence of disease among gazelles and the lack of antibody to FMDVs that wildlife were not involved in the outbreak.

In 2001, by contrast, Mongolian gazelles with antibodies to serotype O were found in 67% of 33 animals sampled on the eastern steppe although there was no clinical evidence of disease in gazelles during that outbreak (Nyamsuren et al., 2006). As already explained, FMD outbreaks in livestock caused by serotype O occurred on the eastern grasslands in 2000 and 2001. It is therefore likely that these sero-positive gazelles acquired the infection from livestock although no clinical disease was observed among gazelles during either outbreak (Nyamsuren et al., 2006). A similar situation has been shown for a preponderance of impala infected with SAT serotypes in the Kruger National Park in South Africa (Keet et al., 1996; Vosloo et al., 2009).

Gazelles were observed to be suffering from FMD before the disease was recognized in livestock in 2004 (Sodnomdarjaa *et al.*, 2007). However, as far as is known, no laboratory evidence was obtained that showed the viruses involved in causing disease in gazelles to be related to livestock isolates. It is nevertheless likely that was the case.

The Asia 1 outbreak that occurred on the eastern steppe the following year, i.e. 2005, apparently did not affect gazelles although no specific investigation was conducted to investigate this possibility.

Both phases of the 2010 outbreak □ spring and autumn (Fig. 1) □ involved livestock and gazelles. Because the outbreak was first identified in livestock it is likely gazelles became infected secondarily. The autumn phase of the outbreak, first identified in August in livestock close to the Russian border of Dornod Aimag, was associated by some observers on the ground with gazelles returning to Mongolia across the Russian frontier at that time. There is, however, no hard evidence for this assertion.

Collectively, these observations indicate that Mongolian gazelles are susceptible to infection with FMDVs and sometimes, but not always, develop disease following infection. However, there is nothing to indicate the pre-eminent involvement of gazelles in FMD outbreaks in eastern Mongolia; the evidence indicates that gazelles have not maintained FMDVs in inter-epidemic periods. It is also likely, although that needs to be proven, that Mongolian gazelles would be less effective in spreading FMDVs than cattle because of the high relative susceptibility of cattle and the fact

that acutely infected cattle generally excrete more FMDV than do cloven-hoofed species other than pigs (Thomson *et al.*, 2003, Thomson & Bastos, 2004).

#### 4.3 Conclusions on the pattern of FMD outbreaks in Mongolia since 2000

From the above it is evident that there were at least 4 new FMDV introductions into Mongolia between 2000 and 2010; 3 belonging to serotype O and a single Asia 1. Other than the possibility that the 2000 and 2001 outbreaks could have been part of a single outbreak, there is no evidence that these new introductions persisted in the animal populations of Mongolia for a significant period after the clinical end-point of the outbreak was reached. It is therefore most unlikely that FMD has been endemic to Mongolia during the last decade at least.

There can be little doubt that until China particularly manages FMD more effectively than at present, the animal populations of eastern Mongolia, wild and domestic, are at high risk of becoming infected with FMD viruses originating across the border.

It is possible that Mongolian gazelles introduced FMDV into Mongolia on one occasion, i.e. in 2004 when the infection occurred in gazelles before livestock. It is also possible gazelles were responsible for re-introducing serotype O to Dornod Aimag in the autumn of 2010 but the evidence in that case is tenuous.

Gazelles were involved in 3/5 outbreaks of FMD on the eastern steppe in the last 11 years, i.e. in the other two (2000 & 2005) there was no evidence of wildlife involvement.

### **5. FMD outbreak prevention in eastern Mongolia**

In the circumstances that prevail on the grasslands of eastern Mongolia □ coexistence of nomadic herders of livestock and a large number of migratory gazelles □ the most appropriate measures that could be employed to minimize the probability of FMD infection crossing into Mongolia are (1) improved management of the border crossing points and fences separating the countries and (2) creation of an effective level of herd immunity in the domestic livestock population through regular and routine vaccination. If resources for this approach are inadequate (these are considerable – see below), realistic alternatives can also be identified.

#### 5.1 Management of the border crossing points and fences separating the Mongolia from neighboring countries

This consultancy was unable because of time, financial and security constraints to undertake a comprehensive analysis of Mongolia's border management practices or the integrity of the fencing systems. One border crossing with China (Khavirga Border Post) was visited and interviews with officials conducted. The border fences in the immediate vicinity were also viewed from a distance but could not be closely inspected.

In the opinion of border officials little illegal movement of people or goods across the border with China occurs. However, commercial trade between China and Mongolia is increasing and although it is unlikely that significant amounts of animal products enter Mongolia because the necessary price differentials do not exist, there is large-

scale importation of horticultural produce from China into Mongolia transported by trucks of various kinds. As indicated above, some effort to disinfect vehicles moving into Mongolia is made using wheel baths at border crossings but basically effective disinfection is not conducted and in any case it is logistically difficult, especially in the extreme cold of winter. How this problem could be addressed will require specific investigation.

Mongolia's border with China is long and up-grading of the fence would obviously be an expensive exercise. Whether up-grading this barrier would be cost-beneficial would be essential to a decision in this regard. Evaluation of the environmental impact would also be necessary, i.e. an environmental impact assessment. However, the proportion of gazelle home-range outside the borders of Mongolia is probably less than 10% (Wingard & Zahler, 2006; Olsen, 2007 – see Fig.2). Therefore, gazelle movement across the border, irrespective of fencing, will likely be limited. The border between Mongolia and China was furthermore effectively closed for many years and so the original ecological impacts of the border fences are now essentially entrenched. Upgrading the fence is therefore likely to have limited additional ecological impact.

#### 5.2 Creation of an effective level of herd immunity in the domestic livestock population through regular and routine vaccination

It is clear from data provided by the Mongolian Government's VABA that vaccination programs directed against FMD have been inconsistent over the last 11 years (Table 2). This is probably a reflection of the intention prior to the events of 2010 to greatly reduce, if not dispense entirely, with prophylactic vaccination of livestock in Mongolia. On the other hand, it is now clear that the animal populations of the eastern grasslands are at continuous high risk from FMD and it would be logical for Mongolia to accept this situation until FMD management in China at least becomes more effective.

Prophylactic vaccination programs to address the situation in eastern Mongolia can only be effective if they generate adequate levels of herd immunity on a continuous basis. To achieve that is technically complicated, logistically taxing and expensive. Furthermore, whether this expenditure and the time and effort required will generate an adequate return is dependent on the Government of Mongolia's (GoM) long-term intentions with respect to livestock production and especially export of animal commodities and products. This is addressed in more detail below.

To develop a vaccination program that will be adequate in the long run will require the following:

- Accurate determination of the target (high risk) livestock population and a way of distinguishing members of this population from animals that are not part of it;
- Deciding which species and ages of livestock need to be vaccinated because blanket or mass vaccination of the entire population may be unnecessary or result in unjustified effort and expense (this requires expert consultation);
- Selection of vaccines that will be most effective, including appropriate serotypes and subtypes (this is discussed in more detail below in Section 6), type of adjuvant and other quality aspects;

- Development of a technically sound vaccination schedule, i.e. intervals between vaccination rounds;
- Assurance that the finances, logistical requirements (vehicles and other equipment) and personnel availability will be adequate to ensure successful application of vaccination program on a routine basis;
- An auditing system □ preferably independent of the implementing Agency □ that will be able to measure the levels of herd immunity generated by the vaccination program on a regular basis;
- Agreement with the Fiscus that additional finance to correct deficiencies identified by the auditing system will be made available promptly.

Many countries throughout the world implement vaccination programs that are deficient in a number of the above respects, the net result being that the time, money and effort expended are frequently wasted. In short, it is important that decision-makers are made aware that unless adequate resources are allocated to a vaccination program on a continuous basis it would be advisable to develop an alternative strategy. This cannot be over-emphasized.

### 5.3 The present FMD-zoning approach under consideration in Mongolia

It is understood that the GoM has essentially decided to implement a zoning approach for future FMD management in the country.

A map of the zoning strategy under discussion is available (Purevkhoo – Appendix E) which shows that 5 areas are envisaged to support the FMD-free zone in the west of the country, i.e. 6 zones in all. These areas/zones are from east to west: ‘vaccinated risky zone’ (incorporating Dornod, Sukhbaatar, Dornogovi & part of Umnagovi Aimags, i.e. most of the eastern grassland), ‘risky zone without vaccination’, ‘control A zone’, ‘protection zone’, ‘control B zone’ and the FMD-free zone (Bayan-Ulgii, Khovd, Uvs, Govi-Altai, most of Zavkhan, most of Khovsgol and some of Bayankhongor Aimags).

So far it has been impossible to ascertain why this number of areas/zones is necessary or what activities in each of these zones will be undertaken and how these will differ from one zone to another. From the perspective of someone from southern Africa where zoning is a long-established FMD management strategy, this plan appears to be seriously over-complicated and likely to be difficult to manage effectively. Furthermore, the FMD-free zone contains less than about 43% of Mongolia’s livestock, i.e. more than half of Mongolia’s livestock will be unable to contribute to exports. This, experience has shown in southern Africa, will lead to discontent and political agitation on the part of livestock owners who do not reside in the FMD-free zone.

Mongolia suffers from the disadvantage that there is no established livestock identification system and livestock movements are essentially uncontrolled. There are also few barriers to animal movement within the country other than natural obstacles such as mountains, lakes and rivers. Therefore, how the integrity of 6 different zones will be maintained is an obvious question. It was established from an interview with members of the European Union-funded project in Mongolia dealing with animal disease management and livestock commodity and product trade, that a

pilot project on animal identification is currently in progress (Enkhtur. B., personal communication).

It has previously been suggested to the GoM, including by the Director-General of the OIE that Mongolia could consider application to the OIE for two zones; one free from FMD where vaccination is not applied and the other where vaccination is practiced. This would have the advantage of rendering some commodities and products from all Mongolian livestock eligible for export □ with slight variation.

Mongolia's zoning strategy would appear to require further consideration if it is to maximize the potential benefits and reduce costs. This will require a variety of inputs, not least from people knowledgeable regarding international trade in meat. Furthermore, it is obvious even without detailed analysis that Mongolia's infrastructure to support international trade in animal commodities and products is rudimentary. For that reason it may be difficult for Mongolian meat and meat products to be competitive in high value markets even if sanitary and phyto-sanitary (SPS) constraints were overcome in the near future.

#### 5.4 Alternative approaches to FMD management

It is increasingly realized that strategies employed to manage FMD need to match the circumstances of the country concerned and in particular export markets that the exporting country is aiming at. It is unfortunately so that many developing countries aspire to accessing the highest value markets without understanding the full gamut of requirements, including competitiveness, for achieving that access while ignoring more accessible markets where standards for imported products are less exacting (Perry & Dijkman, 2010).

Fast-growing economies, particularly in Asia, potentially provide good markets because of the increasing demand for animal proteins by new middle class citizens. In this respect Mongolia has a potentially huge market for meat products on its southern boundary. Mongolia's traditional meat market, Russia, is also geographically well positioned but it is widely known that Russia's sanitary and phyto-sanitary (SPS) import requirements for meat products are high despite the fact that animal disease management in that country is not as effective as it might be. This is presumably at least one reason why the erstwhile annual export of around 20 000 tonnes of beef from Mongolia to Russia has ceased. Horse meat exports are said to have made up for this trade loss to some extent.

This debate has been ongoing in southern Africa for some time and has been summarized in a recent publication (Scoones *et al.*, 2010). Table 3 illustrates the point which is essentially that 'different horses are appropriate for different courses'. So, for example, Mongolia could decide to persist with existing practices for FMD management and handle the situation on an outbreak-by-outbreak basis. Alternatively, FMD-freedom where vaccination is practiced, compartmentalization (see OIE's Terrestrial Animal Health Code – [www.oie.int](http://www.oie.int)), as is being investigated in Kenya at the moment, and the commodity-based trade approach (Thomson *et al.*, 2004; Thomson *et al.*, 2009; Paton *et al.*, 2009; Health Standards: Commodity-based approach: [www.oie.int](http://www.oie.int)) are alternative options. It is often repeated that Mongolia has 'no alternative' to establishment of a FMD-free zone in order to trade internationally in meat and meat products. That is simply incorrect. What is true is that the alternatives are, so far, not widely adopted.

Trade issues and market analysis are not within the ToRs for this investigation and this aspect will not be taken further here. It is, nevertheless, emphasized how important it is to match FMD management strategies with the resources available within countries □ in this case Mongolia □ as well as medium- and long-term trade aspirations. Understanding that FMD management may also have serious environmental consequences, especially where wildlife complicates the establishment of FMD-free zones, is also vital (SADC, 2009).

## **6. Management of FMD outbreaks in Mongolia**

Mongolia is at high risk of future FMD outbreaks, even more so if improved outbreak prevention is not instituted systematically and sustainably in the near future. It is consequently essential that Mongolia ensures that it has efficient and effective control measures in readiness for future outbreaks.

At the moment the country is not recognized as FMD-free and there are no likely trade consequences if and when outbreaks are reported. Mongolia needs to develop well organized and financed response plans but there is no reason to regard FMD outbreaks as an unmitigated disaster: No people and few animals will die and trade consequences will be very limited. It is important to ensure that the reaction to FMD does not result in economic loss greater than result from the disease itself. This message, of course, needs to be shared with the relevant decision makers as soon as possible because they will certainly not understand this point of view in the heat of an outbreak.

Mongolia's response plan to FMD outbreaks is well documented and generally well thought out (VABA, 2010). Essentially, it is based on the following:

- Creation of a control zone that includes
  - Outbreak zone
  - Zone of suspicion
  - Protection zone
- Quarantine activities
  - Quarantine of livestock - maintained until 3 weeks after completion of vaccination
  - Control of human & traffic movements
- Modified stamping out – with compensation at a rate of 90% of market value
  - The guide does not mention stamping out of wildlife
- Two-3 rounds of disinfection
- Vaccination in the vaccination zone – free of charge for livestock owners
- Other activities
  - Creation of awareness among livestock owners & the general public
  - Organization of interdepartmental collaboration

There are two of these activities that it would seem are worthy of reconsideration, *viz.* the application of 'modified stamping out' (MSO) as it was applied in 2010 and the extent to which 'disinfection' is carried out. It is argued here that much more practical/cheaper but equally effective and environmentally more responsible management practices could be implemented.

## 6.1 Modified stamping out

The concept of 'stamping out' is very old in the veterinary field and firmly enshrined in the recommendations of the OIE's Animal Health Code, including with respect of FMD<sup>4</sup>. The idea is that if, soon after the start of an outbreak of a contagious disease, the infected animals and susceptible animals in contact with them are humanely killed and safely disposed of, further transmission of the infection will be halted. The reasoning cannot be faulted. However, the problem is that it frequently takes some weeks or even months to diagnose a disease outbreak (especially where extensive animal systems are involved) and bring the emergency response plan based on 'stamping out' into action. When that occurs, the number of animals that need to be 'stamped out' is frequently so large that the whole exercise becomes logistically unmanageable. This is what happened in the UK in 2001 and, most likely, in South Korea in 2010/11.

Modified stamping out (MSO) is any modification of full 'stamping out'. In Mongolia's case the idea is that only animals that are clinically diseased need to be killed because these animals are likely to become 'carriers'<sup>5</sup> of the infection after recovery. The presumption is that animals that do not become diseased (for example, sub-clinically infected animals) do not become carriers. However, there is no scientifically-based support for such a conclusion. In fact there is no scientific basis for any of these assumptions in the case of FMD.

It has been shown repeatedly that a proportion of some, but not all, ruminants that have undergone infection with FMDV retain the infecting virus in the mucosa of the oro-pharynx for variable lengths of time. Animals in which the infecting virus persists in the oro-pharynx for longer than 4 weeks are referred to as 'persistently infected' (Salt, 1993; Thomson & Bastos, 2004). This has been shown to occur in African buffalo (*Syncerus caffer*, which only rarely develop clinical disease following natural infection), cattle, sheep and some wildlife species (Thomson – Appendix D). However, with the exception of African buffalo where carrier transmission to other buffalo and cattle has been conclusively demonstrated, carrier transmission by persistently infected domestic ruminants and wildlife has not been proven on any continent despite many decades of study and observation. Therefore while carrier transmission by cattle, sheep and goats may not be impossible, in practical terms this eventuality can be discounted.

An argument could be made that MSO has been so successfully carried out in Mongolia in the past that no carriers have remained to transmit the infection after outbreaks have ended. However, it is well known that in extensive systems such as those in southern Africa and Mongolia, progress of infection in infected herds is often slow, i.e. it takes weeks for most animals in an infected herd to become infected by their cohorts and develop FMD (G R Thomson, personal observation). Some infected individuals do not develop clinical disease. In such circumstances it is difficult to identify all infected animals in a herd because infection and recovery are proceeding continuously. Furthermore, some animals, especially sheep, goats and some antelope frequently develop FMD lesions that are so mild they are difficult to detect

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<sup>4</sup> For definition of 'stamping out' see glossary of the Terrestrial Animal Health Code ([www.oie.int](http://www.oie.int))

<sup>5</sup> Carriers are animals that have recovered from the acute phase of an infection (i.e. are clinically normal) but continue to harbour that infection in their bodies (i.e. remain persistently infected) and may at some future date excrete that infection and thereby re-initiate the disease in the same or a distant locality

(Thomson & Bastos, 2004). It needs also to be remembered that animals may be capable of transmitting FMD for several days before they develop lesions (Thomson & Bastos, 2004). So identification of all infected animals under such circumstances is essentially impossible. So, for example, it came to light after the 2010 outbreak in Mongolia had ended that at least one herder reported that he had recovered animals that were not culled.

During the 2010 outbreak, 26 933 livestock were 'stamped out' at a cost of approximately 2.5 billion tugriks (about \$[US] 2 million). Approximately the same amount of money was spent on vaccination in the outbreak area; these two being by far the largest costs associated with the outbreak (Purevkhuu – Appendix D). By simple deduction it is obvious that the cost and workforce for managing the 2010 outbreak could have been approximately halved by not applying MSO.

MSO was also applied to Mongolian gazelles in the outbreak area by driving herds using vehicles to identify animals that lagged behind. These animals were then shot and buried □ 1616 in all. It is intuitively obvious that many gazelles that were infected were not culled, for example animals that developed disease early in the outbreak and had recovered or those with mild disease. In such cases the logic behind MSO is difficult to understand.

The question arises as to what would or could have been the consequences had MSO not been applied to livestock and wildlife during the outbreak of 2010. The simple answer to this question is 'very few if any' negative sequels as long as infected and in-contact herds of livestock had been effectively isolated and vaccinated. If that had been done the infection would quickly have been brought to an end. This clearly did not happen; the reasons and possible solutions are addressed below.

The simple fact is that if livestock are quarantined, human and traffic movement controlled and effective vaccination instituted in an extensive area such as the rural areas of Dornod Aimag, potential consequences are limited. In FMD almost all animals with the exception of very young calves and lambs/kids recover from the disease in a week or 10 days. Killing diseased animals may shorten the time taken to reach clinical end-point in infected herds but that is all. The most important factor in ensuring a swift end to an outbreak is to ensure that the population becomes effectively immune as soon as possible. That was the purpose behind the historic practice of 'aphthization'<sup>6</sup>.

A difficulty arose in the 2010 outbreak because the response to vaccination within the outbreak focus and surrounding areas was less satisfactory than it should have been. At least one important reason for that has now come to light, i.e. the serotype O vaccine strain in at least one of the vaccines used to manage the outbreak was poorly 'matched' with the viruses causing the outbreak (Table 4). However, measures can be instituted to minimize a repeat of this eventuality in future.

There are some clearly negative factors associated with MSO as it was practiced in 2010. In the first place, chasing gazelles with vehicles to identify lame and otherwise

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<sup>6</sup> Aphthization is the historic practice of collecting epithelium from infected animals within an outbreak and using that to prepare an inoculum that is injected into all healthy animals in the outbreak so that all animals become infected quickly and then recover at the same time

unhealthy animals could be a significant factor in dispersal of the infection. Secondly, among livestock owners in other parts of the world – for example southern Africa – the experience is that the threat of stamping out leads to some owners trying to move their valuable animals out of the outbreak area with obvious negative consequences. Stamping out also often sours the relationship between the animal health authority and livestock producers resulting in poor future cooperation. However, in Mongolia it is evident that in this respect the herders bear no grudge against the MSO conducted in 2010. The question arises as to why this is so. Although this would require more detailed investigation, it seems possible that as a result of the closure of the export abattoir in Choibalsan<sup>7</sup>, there are now more limited outlets for the sale of livestock in Dornod and nearby Aimags. If that is the case it may explain why the herders were satisfied with the 90% compensation they received for culled animals, i.e. they may have been happy to lose approximately 5% of their herd (the apparent average number of animals culled within the susceptible population – Purevkhuu – Appendix D) for this level of compensation because conventional markets are oversupplied.

In summary it is proposed that the VABA and other relevant agencies should reconsider the issue of MSO. It is not thereby suggested that full stamping out should in future be imposed because in an area that is not trading internationally (based on recognition of FMD-free status) that would not make sense. Rather, the Agencies could consider minimizing MSO in future – especially in respect of wildlife – and place more emphasis, i.e. money and personnel, on effective vaccination.

## 6.2 Disinfection

It is evident from discussion with National Government and Dornod Aimag officials involved with the control of the 2010 FMD outbreak, as well as from the VABA guideline<sup>8</sup>, that great emphasis is applied to disinfection in the management of FMD outbreaks in Mongolia. While cleaning and disinfection is an important facet of the management of most infectious agents, in Mongolia there are a number of practical aspects that appear to be misunderstood.

This issue is dealt with in more detail in section 9 below.

## 7. Vaccines & vaccination against FMD

From the foregoing sections it is clear that vaccination against FMD in the eastern steppe region of Mongolia will need to be maintained as a prophylactic measure and for countering outbreaks of the disease for the foreseeable future, i.e. as long as neighboring countries remain a threat and effective management of FMD in Mongolia is retained as an objective.

From figures on vaccine use in Mongolia over the last 11 years it is clear that there has so far not been a consistent policy because the number of doses administered annually fell from a peak of 14.3 million doses in 2002 to 1.6 million in 2009 (Purevkhuu – Appendix D). This is likely a reflection of Mongolia's previous intention

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<sup>7</sup> Up to quite recently about 20 000 tonnes of beef were exported from this abattoir to Russia annually

<sup>8</sup> 'Guidelines to control livestock diseases' published by the Veterinary and Animal Breeding Agency in 2010

to apply to the OIE for recognition of Mongolia as a country free from FMD where vaccination is not practiced. Hindsight, however, shows that the eastern steppe of the country is still at high risk from neighboring countries and that it is unlikely to be possible in the near future to obtain recognition for the eastern part of the country as a FMD-free zone without vaccination even though the western part of the country may qualify.

### 7.1 Vaccination programs

The question arises as to what sort of vaccination program would be necessary to protect the eastern steppe region from infection derived from neighboring countries, primarily China. This will to a large extent be dependent upon the budget that the VABA can secure for this exercise on a routine basis. However, based on past experience the livestock within Dornod, Sukhbaatar and Dornogovi Aimags need to be routinely vaccinated. The total livestock population susceptible to FMD (cattle, sheep, goats and camels) in these 3 aimags is approximately 4.2 million which is a large number of animals to vaccinate regularly (the number of doses of vaccine that will need to be administered annually will also depend on the adjuvant incorporated into the vaccine purchased).

Because cattle are generally more susceptible to infection with FMDV than sheep and goats and also excrete FMDVs efficiently, consideration could be given to vaccinating only cattle in which case the number of animals falls to about 276 000, a figure which is likely to be a more affordable and manageable. This, however, is a complex issue and requires careful analysis.

### 7.2 Antigenic composition of future vaccine purchases

In the recent past trivalent FMD vaccine (i.e. containing serotypes O, Asia 1 & A) has been used in Mongolia on an annual basis. However, in the most recent (2010) outbreak, based on an independent report, it is clear that the O<sub>1</sub> Manisa vaccine strain incorporated into one of the vaccines used in an attempt to contain the outbreak was poorly matched with outbreak isolates (Table 4).

This was a surprising finding because O<sub>1</sub> Manisa is generally an effective vaccine strain in serotype O outbreaks. This event shows how important it is to be careful about which vaccine strains are incorporated into purchased vaccine.

Mongolia's past experience with FMD suggests an approach which may be more focused and therefore effective in future. Six of the last FMD outbreaks of FMD in Mongolia resulted from serotype O introductions; for that reason it may be worthwhile in the near future for Mongolia to purchase vaccines that contain vaccine strains representative of more than one O subtype. So, for example, Mongolia could for the next year purchase vaccine containing O<sub>1</sub> Manisa and another O strain that is representative of a different O subtype prevalent in south-east Asia. Advice in this regard could be obtained from the FAO World Reference Laboratory in the UK. The vaccine ordered could then, if reference laboratories so advise, dispense with either serotype A or Asia 1. The price of the vaccine should in that case remain about the same.

It is also possible  and advice in this respect was provided to the relevant personnel  that the Central Veterinary Laboratory, because it has a P3 facility, could develop

simple tests to screen the likely efficacy of vaccine in use against new viruses that may be introduced into Mongolia in future.

In section 4.2 it was emphasized that it is important not only to have an effective routine vaccination program against FMD but that auditing of the program is equally vital, i.e. that the program achieves the targets set.

In summary Mongolia would be well advised to re-institute a routine vaccination of livestock (cattle at least) in the aimags that have been shown by past experience to be at highest risk. Auditing the program to ensure its efficacy is also important.

## **8. What about Mongolian gazelles in future outbreaks of FMD on the eastern steppe?**

Gazelles were infected in 3/5 outbreaks on the eastern steppe and in one case may even have introduced the infection into the country (Table 1). However, it is important to appreciate that 3 of these viral introductions were simply extensions of Asian FMD pandemics that crossed the borders of many countries where there is little or no likelihood of wildlife involvement. Put another way, it would have been surprising if Mongolia had escaped becoming part of these pandemics even if the possibility of wildlife involvement were nil.

Because there is very little transboundary movement of Mongolian gazelles it is likely that other avenues of introduction pose far more risk of introducing FMD into Mongolia. On the other hand, to assume without any supporting evidence, that once the infection is introduced gazelles would not be involved in spreading outbreaks on the eastern steppe would be unwise. To minimize this possibility it is essential that livestock of the eastern steppe □ cattle at least because of their high susceptibility to infection with FMDVs □ possess adequate levels of herd immunity against FMD viruses prevalent in south-east Asia. In such circumstances gazelles would not be likely to infect livestock even if they became infected.

## **9. Misinformation regarding FMD in Mongolia**

The 2010 FMD outbreak in Mongolia started in Dornod Aimag and for that reason the overall control of the outbreak □ in accordance with administrative policy in Mongolia □ fell to the Dornod Aimag Professional Inspection Agency (DAPIA) with technical animal health tasks and standards being provided by the VABA, the National Emergency Management Agency (NEMA) and the National Emergency Committee (NEC).

In order to assist personnel in the field and also, it would appear, to inform the general public the DAPIA distributed at least 3 fliers under the heading of, 'Recommendations and guidelines to protect the public during livestock disease outbreaks'. These were contained in 3 sets of guidelines:

- Public prevention methods during livestock disease outbreaks;
- FMD prevention possibilities (directed at the human population);

- Recommendations and guidelines for disinfecting water and water resources.

English translation of these guidelines is provided in Appendix E.

The above documents are indicative of serious misunderstanding of the epidemiology of FMD in Mongolia that, in turn, probably explains some of the inappropriate actions undertaken by the authorities in controlling the 2010 outbreak. It also shows that people within the VABA, who do understand the epidemiology of FMD, seemingly made no inputs into these documents and also have little influence over some actions undertaken in the field. The most serious misunderstandings are:

- FMD is indicated to be a zoonosis with significant effects on people (it is equally clear that FMD and the human disease 'hand, foot and mouth disease' are confused by the apparent assumption that they are synonymous<sup>9</sup>);
- Species susceptibility is misunderstood; horses, for example, are indicated as being susceptible;
- Disinfection in general and its application in particular, is misrepresented.

At the end of the DAPIA guidelines a statement is made that they were based on 'Guidelines to control livestock diseases' published by the Veterinary and Animal Breeding Agency in 2010. This seems, at best, to be an exaggeration because few if any of the misunderstandings/misinterpretations are mentioned in the VABA guidelines (E. Shiilegdamba, personal communication).

Disinfection without first cleaning surfaces to be disinfected is basically a waste of time, money and effort because most disinfectants are rapidly neutralized by biological materials such as soil and feces, but this aspect is not mentioned in the DAPIA guidelines. For example, spraying the bodies of culled gazelles with liquid disinfectant such as formaldehyde before burial, as apparently occurred in the 2010 outbreak, is pointless. If the gazelles concerned were in the acute stage of infection and were to be dug up by people or scavengers, disinfection would have no effect on the infectivity contained within the carcass. To prevent such an eventuality the carcass should be covered in quick-lime (CaO) before filling in the grave to discourage animals or people from exhuming carcasses.

Although it apparently did not happen in Dornod Aimag in 2010, the use of chlorine to disinfect wells and water sources was planned as a control measure. Such action is unlikely to have a significant impact on the spread of outbreaks because transmission by water presupposes that infection will take place orally. It is well known that oral transmission of FMD in ruminants is inefficient (Thomson & Bastos, 2004). On the other hand, administering disinfectants to water sources may have untold environmental effects. Such a practice should therefore have no part in FMD outbreak management in natural ecosystems.

Apparently attempts were made to control the spread of infection through disinfecting the mouths of people □ for example, passengers embarking for Ulaanbaatar at

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<sup>9</sup> Hand, foot and mouth disease (HFMD) and FMD are both caused by members of the Family *Picornaviridae* but the specific pathogens are members of different genera: HFMD is usually caused by Coxsackie A16 (Genus Enterovirus) and affects people exclusively while FMD is caused by members of the Genus Aphthovirus and affects cloven-hoofed animals and *Camelidae*

Choibalsan Airport □ during the 2010 outbreak. There is no reason to believe that this measure would be effective because FMDV is not a zoonosis in any practical sense and would be very unlikely to be transmitted by airline passengers who are most unlikely to come into contact with animals within a few hours (Thomson & Bastos, 2004). Although small amounts of FMDV may passively persist for 24 hours or so in the pharynx of people exposed to aerosols (this should not be confused with infection) generated by infected animals, for such people to transmit the infection they would have to handle animals directly. Mouth disinfection is also unlikely to be effective unless the people concerned were required to gargle with an appropriate disinfectant because passively acquired infection lodges in the pharynx □ not the mouths of people.

It needs to be remembered that outbreaks of FMD in most parts of the world have been successfully managed without resort to the extraordinary measures sometimes apparently undertaken in Mongolia.

Some of the disinfectants recommended in the DAPIA guidelines, including concentrations, are also inappropriate. However, that is a specialized field and not within the ToRs of this investigation and it will therefore not be addressed further. The VABA is strongly advised to reconsider disinfection practices, possibly with the help of experts on that subject, as also suggested in the FAO/OIE mission report (FAO/OIE, 2010).

## **10. Major knowledge gaps**

As far as FMD and Mongolian gazelles are concerned it would be useful to better understand the routes and quantities of FMDV excretion by gazelles, whether they become persistently infected or not and, even though it is most unlikely, whether they can serve as carriers. However, to obtain this information will require a series of studies involving experimental infection of gazelles with a variety of FMDV isolates. Experiments with different viral isolates is necessary because work on wildlife species in South Africa has shown that animals sometimes react differently to different viral isolates, albeit that the viruses were SAT serotypes. Therefore, unless there are adequate bio-secure facilities and commitment to funding such long-term work in Mongolia it may be better to look at alternatives. It is questionable whether suitable bio-secure facilities exist in Mongolia. This is apart from the moral problem of subjecting healthy animals to the torture of capture and confinement, not to mention invasive experimental procedures.

A more rewarding, affordable and useful line of investigation would be to institute regular, statistically based, serological monitoring of the gazelle population of the eastern steppe for FMDV infection. This would provide useful data on the dynamics of infection in gazelles as demonstrated by a recently published account of a longitudinal study conducted in the Kruger National Park of South Africa (Vosloo *et al.*, 2009). As indicated above, periodic sampling of gazelles on a limited, cross-sectional basis has been conducted in Mongolia in the past but that is clearly inadequate.

From a broader perspective, considered from the vantage point of an outsider, the major deficiency in Mongolia's approach to managing FMD appears to be lack of reasoned policy development. It is evident that the VABA has a plan to establish a

FMD-free zone in the west of the country but there is no indication that adequate assessment of the probable benefits and costs has been conducted or even whether the plan is actually feasible (for instance, the 6-zone plan appears to be inordinately complicated and cumbersome). It is also unclear whether other alternatives have even been considered. For these reasons it is suggested that policy formulation with respect to FMD is the most important current 'knowledge gap' in Mongolia. However, policy formulation is a national prerogative with political implications and therefore, other than this observation, further comment will be confined to technical issues.

The major point made by this report is that the priority for improved FMD management in Mongolia is establishment of a high level of herd immunity to FMDVs in the high-risk livestock populations of the eastern steppe through regular vaccination. Requirements for achieving this objective have been listed above but a major issue is the viral vaccine strains most appropriate to current FMD threats. In the past, as previously stated, Mongolia has used trivalent vaccine (containing O, A & Asia 1 serotypes) with no specific attention to matching vaccine strains with viral subtypes posing a threat in south-east Asia. It is clear in retrospect that at least some of the vaccine used to combat the 2010 outbreak did not contain a serotype O vaccine strain that adequately matched the outbreak viruses. For the future two 'knowledge' issues related to this need to be specifically addressed:

- Monitoring through contact with appropriate reference laboratories the viruses circulating in south-east Asia so that vaccines purchased in future will 'match' viral variants circulating in the region as far as possible. This could be included in the mandate of the State Central Veterinary Laboratory.
- Consideration of adapting the present approach to vaccine purchases to ensure that broad antigenic coverage against serotype O is achieved (because serotype O is clearly the most common threat). This could be done through incorporation of two or more serotype O vaccine strains into future vaccine purchases as explained in 6.2 above.

While these are not knowledge gaps in the strictest sense, it is logical to presume that a better understanding of these issues in Mongolia needs to be developed (with someone or some organization formally tasked in that respect) together with an ability to use that knowledge to negotiate with vaccine suppliers.

A related issue concerns definition of the livestock population at high-risk of exposure to FMD on the eastern steppe, i.e. the population that needs to be vaccinated routinely. Clearly, the smaller this population the easier and cheaper FMD prevention will become. This assessment should not only consider the appropriate geographic area but also the species mix for vaccination. These decisions need to be reached taking all aspects, i.e. technical understanding, local circumstances and available resources, into account. A further aspect is developing a method for identification of the vaccinated population that can be used to differentiate animals within the vaccinated population from those that are not part of that population.

## 11. Conclusions

The available evidence indicates that FMD is not endemic to Mongolia. However, experience over the last 11 years has shown that livestock and Mongolian gazelles on the eastern grasslands are at high risk of being infected with FMD viruses that arrive from neighboring countries, China particularly. The precise mechanisms of introduction are unknown but some normal trade activities as well as cross-border movement of animals, livestock primarily, are obvious risk factors. Once FMD infection has been introduced onto the eastern steppe the probability is that both livestock and wildlife may be involved in the spread of the infection. However, cattle are likely to be the most important species in this respect.

Two actions are needed to address this on-going threat: (1) improvement of bio-security practices at border crossings and up-grading the integrity of Mongolia's fence along the border with China, i.e. improvement of border protection against FMD and (2) institution of regular vaccination of livestock against FMD to achieve adequate levels of herd immunity in the high-risk population. The latter action can be undertaken immediately and therefore should be considered a priority. Some issues with regard to vaccine practices require improvement and recommendations in that regard are provided (see below).

It is likely that even with improved border protection and effective vaccination of the target livestock population, occasional outbreaks of FMD will still occur in the future. However, there is no need, if adequate planning and management are instituted, for these outbreaks to be disastrous and it is important that this message is conveyed to decision-makers. It is furthermore essential that the impacts of control measures do not exceed those of the disease itself. In this regard, alteration of two current practices is recommended □ i.e. modified stamping out (MSO) and disinfection methodologies □ that are part of the usual approach to managing FMD outbreaks in Mongolia. The identified practices are inconsistent with scientifically-based approaches to FMD management. This is particularly so in the case of gazelle populations. Amending these practices along the lines recommended will improve outbreak management and reduce its cost, while at the same time ameliorating the impact of disease management activities on livestock production, wildlife conservation and the environment.

The administration of decision-making in response to FMD outbreaks, at least in Dornod Aimag, requires review because measures were instituted on 2010 that are at odds with current understanding of the epidemiology of FMD. It appears that in some cases decisions were made by people in senior administrative positions who either lacked the necessary technical background and knowledge or were poorly advised.

## 12. Recommendations

The list of recommendations below is not intended to be comprehensive but to identify what are considered to be critical issues that need to be addressed to bring about more effective prevention and control of FMD in Mongolia:

- The relevant authorities in Mongolia would be advised to review border protection against FMD at crossing points and along border fences, especially those with China. A number of specialist inputs would be required to do that effectively.
- Experience over the last 11 years has shown that both livestock and Mongolian gazelles on the eastern steppe are at high risk of FMD infection. The VABA should therefore (1) define as accurately as possible the high-risk livestock population that needs to be protected, (2) develop a vaccination program for that population that will ensure high levels of herd immunity on a continuous basis and (3) ensure that vaccine strains incorporated into future vaccine purchases are selected to ensure 'matching' with FMDVs that threaten Mongolia.
- Review of the current plan for establishing a FMD-free zone in the west of Mongolia is recommended because it appears that alternative approaches and even other zoning systems have not been adequately assessed especially in respect of potential benefits and costs. In particular, there is a possibility that two disease-free zones could be created covering the whole of Mongolia that would enable access to international meat markets for both zones. The present plan appears over-complicated and is likely to result in future political pressure from those regions of the country that will be excluded from access to export markets.
- Because SPS issues are not the only potential barriers to future meat exports and the capacity to compete successfully in target markets is vital, Mongolia would be wise to focus on production and marketing issues that will enable its meat products to be competitive in external markets.
- The practice of 'modified stamping out' □ both of livestock and wildlife □ and disinfection practices during FMD outbreaks should urgently be reviewed because they are inconsistent with current scientific understanding, quite apart from being of doubtful efficacy and potentially damaging to livestock production, wildlife conservation and the environment. Furthermore, modifying these practices would significantly reduce the cost of managing future FMD outbreaks.
- Review of administrative procedures related to FMD outbreaks in Mongolia appears to be necessary because some of the decisions taken in 2010 appear to have been made by people lacking the necessary technical background. The result was that expensive and socially disruptive measures were conducted with limited positive effect. Therefore, unless they are reviewed these inappropriate procedures will likely be repeated in future.
- The purchasing system for FMD vaccines in Mongolia is presently such that it is difficult for the animal health authorities to ensure that FMD vaccines purchased outside the country contain the most appropriate vaccine strains. It is important that the system is modified to address this problem; otherwise vaccine control of FMD in Mongolia cannot be expected to be efficient.

- It is recommended that a statistically based, on-going, i.e. longitudinal, program be introduced to monitor FMDV infection of Mongolian gazelles on the eastern grasslands of Mongolia.

### 13. Acknowledgements

The staff of the WCS office in Ulaanbaatar is sincerely thanked for unflinching consideration, good humour and assistance during the course of this consultancy. In particular, Drs Amanda Fine and Enkee (Enkhtuvshin) Shiilegdamba provided invaluable inputs, advice and hospitality. Dr Shiilegdamba also translated the contents of Appendix D into English from Mongolian.



*This report was made possible by the generous support of the American people through the United States Agency for International Development (USAID), under the terms of USAID/Sustainable Conservation Approaches in Priority Ecosystems Cooperative Agreement No. EEM-A-00-09-00007-00. The contents are the responsibility of the Wildlife Conservation Society and do not necessarily reflect the views of USAID or the United States Government.*

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# Foot and Mouth Disease Outbreaks in Mongolia (2000 - 2010)

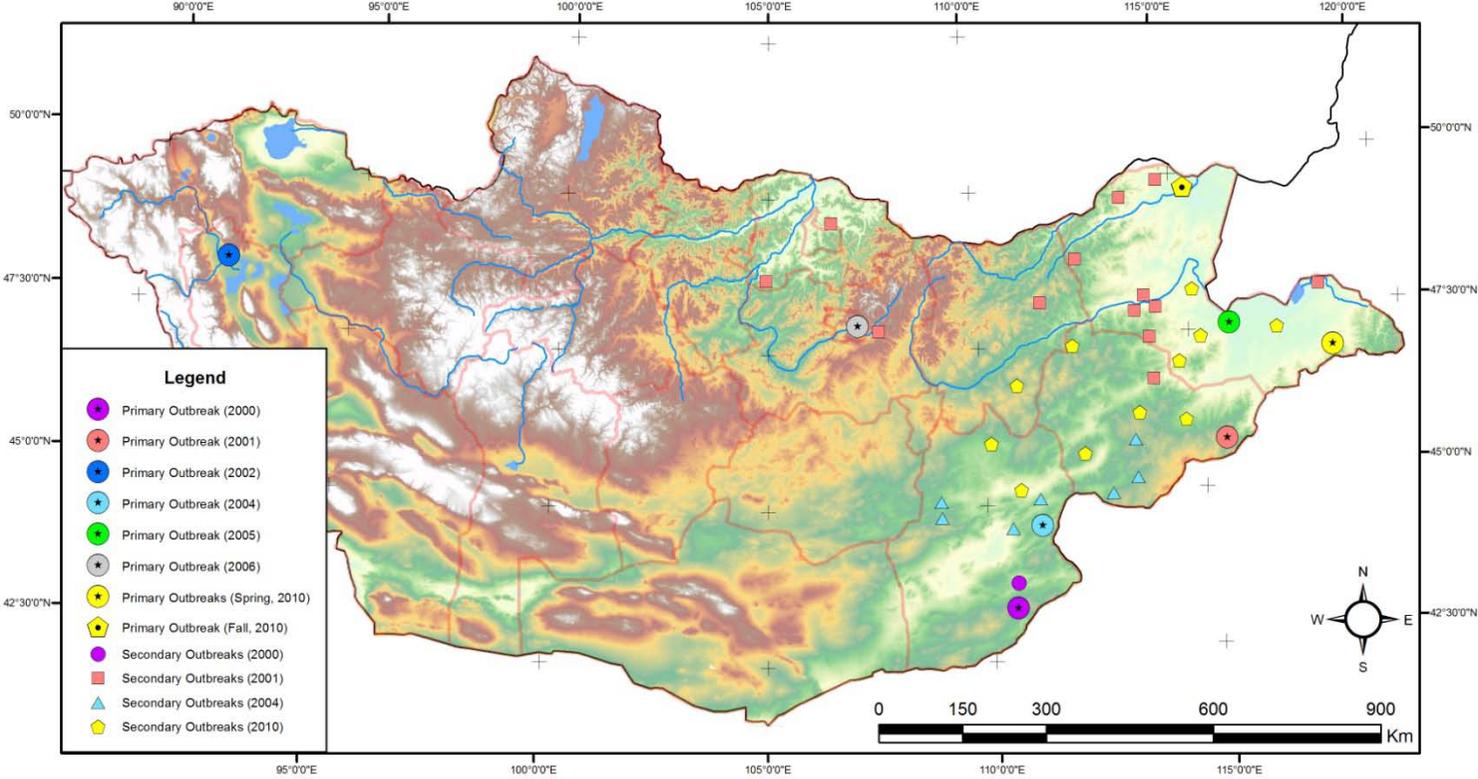


Fig. 1

Locations of primary and secondary outbreaks

# Report on FMDV O in Mongolia in 2010

Batch: WRLFMD/2010/00033

Software: MEGA 4.0  
 No. of Taxa : 253  
 Data File : n:\evd\meg\ldb\fmv\io\MOG2010b.meg  
 Data Title : O Mongolia 2010  
 Data Type : Nucleotide (Coding)  
 Analysis : Phylogeny reconstruction  
 Tree Inference : =====  
 ->Method : Neighbor-Joining  
 ->Phylogeny Test and options : Bootstrap (1000 replicates; seed=64238)  
 Include Sites : =====  
 ->Gaps/Missing Data : Pairwise Deletion  
 ->Codon Positions : 1st+2nd+3rd+Noncoding  
 Substitution Model : =====  
 ->Model : Nucleotide: Kimura 2-parameter  
 ->Substitutions to include : d: Transitions + Transversions  
 ->Pattern among Lineages : Same (Homogeneous)  
 ->Rates among sites : Uniform rates  
 No. of Sites : 639  
 No Of Bootstrap Reps = 1000  
 Only bootstrap values of 70% and above are shown

\* , not a WRLFMD Ref. No.

N.J. Knowles & J. Wadsworth, 26 October 2010

© Institute for Animal Health

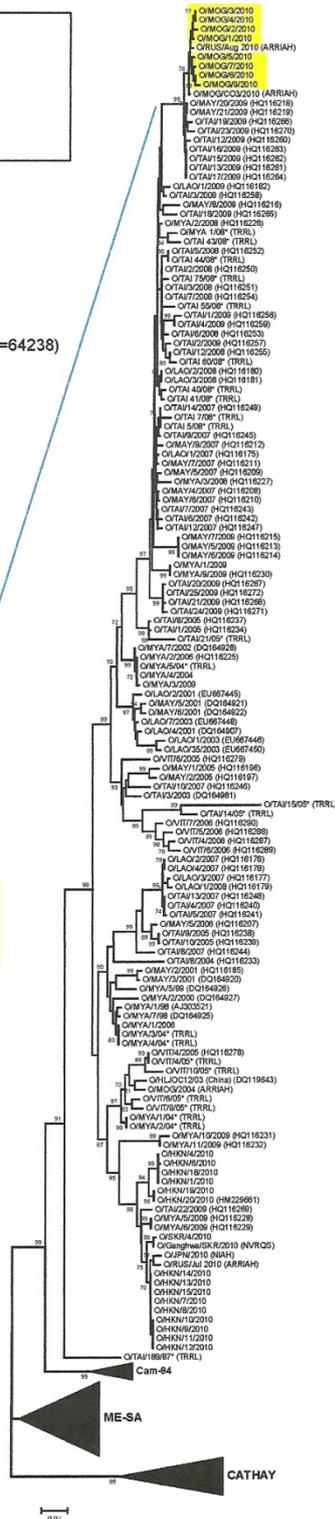
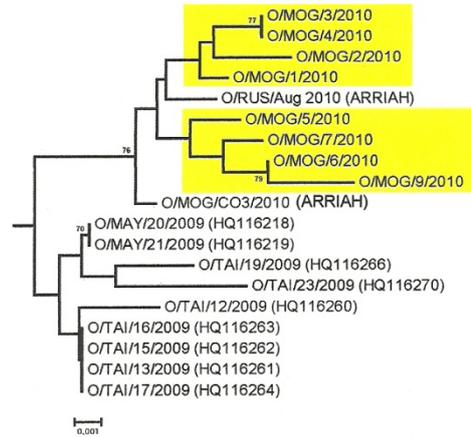


Fig. 2

Scan of a report on the phylogenetic relationships between serotype O viruses from Mongolia & other isolates within the SEA topotype (O/Mong/9/2010 is an isolate made from a gazelle at Khalkhogol, Dornod Aimag)

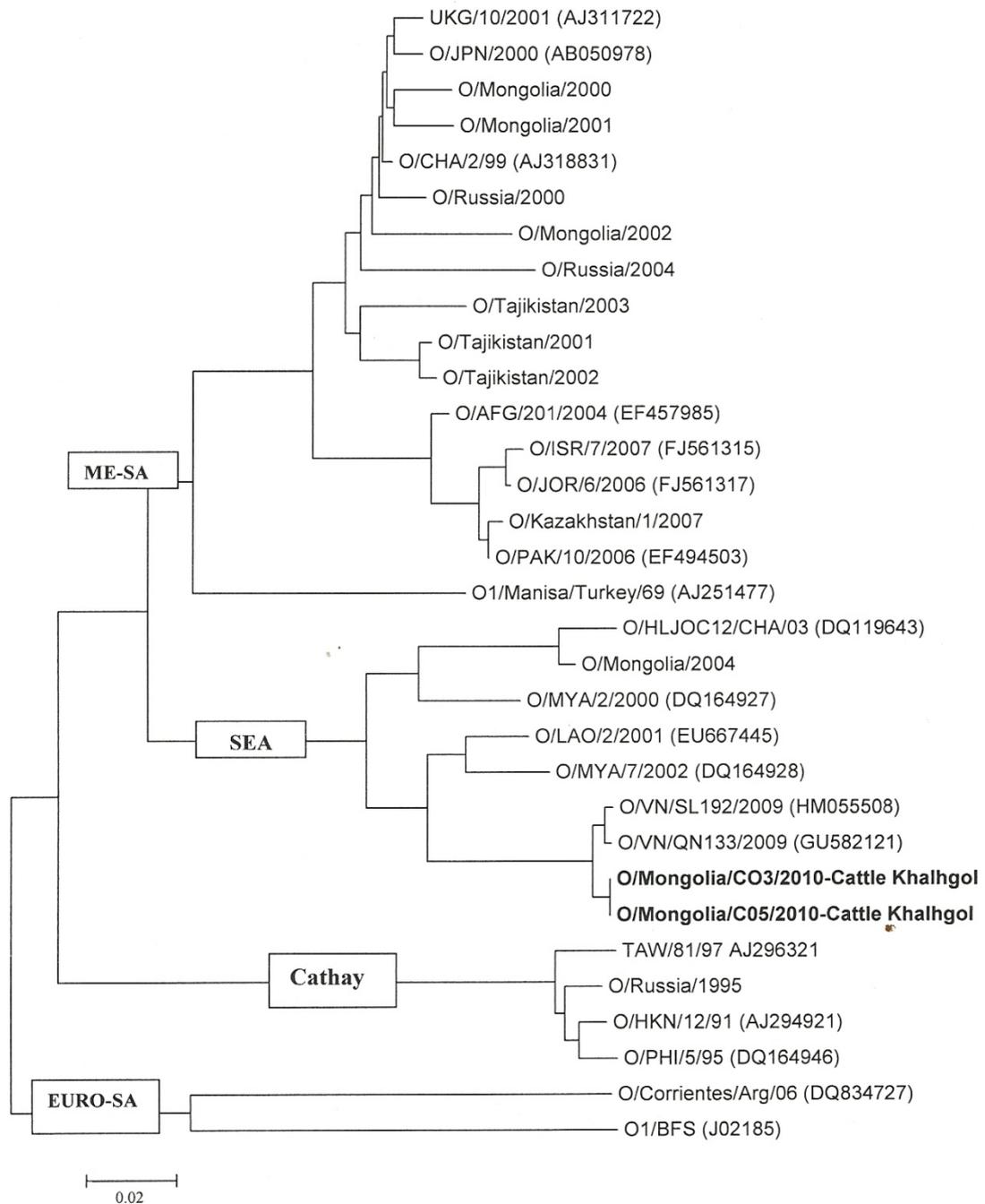


Fig. 3

Neighbor-joining tree of two 2010 Mongolian serotype O viruses & their relationship with other serotype O isolates including those of the 2000, 2001, 2002 & 2004 Mongolian outbreaks

Data supplied by the State Central Veterinary Laboratory: Data originally obtained from the ARRIAH in 2010

Table 1

Outbreaks of FMD in Mongolia: 2000-2010

Duration of outbreak	Initial outbreak location (aimag)	Viral sero-type	Spread (see Fig. 1)	Vaccinated population/not (Y/N)	Gazelle involvement (Y/N)	FMD in gazelles before livestock (Y/N)
April-? 2000	Dornogobi	O	Limited	N	N	N/A
Feb-May 2001	Sukhbaatar	O	Extensive	N	Y	N
July-? 2002	Khovd/Banyan-Ulgii	O	Limited	N	N/A <sup>1</sup>	N/A
Feb-April 2004	Dornogobi	O	Significant	Y	Y	Y
Aug-Oct 2005	Dornod	Asia 1	Limited	Y	N	N/A
April 2006	Tuv	O	None	N	N/A	N/A
April-Dec 2010	Dornod	O	Extensive	Y	Y	N

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<sup>1</sup> Not applicable

Table 2

Annual number of animals vaccinated against FMD in Mongolia: 2000-2010<sup>1</sup>

Year	No. Aimags	No. Soums	Cattle (x 1000)	Sheep & goats (x 1000)	Others <sup>2</sup> (x 1000)	Total (million)
2000	1	11	75.9	806.1	32.4	0.9
2001	11	102	1 377.1	8 613.5	281.7	10.3
2002	13	104	1 446.2	12 481.4	338.1	14.3
2003	10	85	814.9	8 122.9	1 172.3	10.1
2004	9	75	340.0	4 063.4	54.2	4.5
2005	10	61	295.3	3 972.1	99.5	4.4
2006	6	64	433.9	2 415.9	133.0	3.0
2007	6	65	426.1	2 788.4	148.7	3.4
2008	8	72	454.5	4 462.6	104.6	5.0
2009	4	49	299.3	1 168.1	93.3	1.6
2010	7	71	506.3	6 185.0	29.7	6.7
Average	7.7	69	588.1	5 007.2	226.1	5.9

<sup>1</sup> It is presumed that most animals were vaccinated at least twice during the year and therefore the actual numbers of animals are probably about half those shown in this table (data derived from the power point presentation of Ts Purevkhuu – see appendix E)

<sup>2</sup> Includes camels, pigs & ‘young animals’

Table 3<sup>1</sup>

Ballpark relationships between FMD control strategies and market options<sup>2</sup>

FMD management strategy	Market options (ranked according to probable trade value)					
	High value markets, e.g. EU	Direct export to large retailers	Export to emerging markets	Regional trade	Domestic urban markets	Local marketing
Geographic freedom from FMD (country or zone) without vaccination	X	X				
Geographic freedom from FMD (country or zone) with vaccination			X			
Compartmentalization		X				
Commodity-based trade			X	X		
Managing FMD on outbreak by outbreak basis					X	X

<sup>1</sup> Table adapted from Fig.1 of paper by Scoones *et al.*, 2010

<sup>2</sup> The underlying assumption is that the cost of FMD management needs to be balanced against the potential return realisable from target markets

Table 4

‘r-value’ results supplied by the Institute for Animal Health (‘FMD vaccine matching strain differentiation report’) for 3 Mongolian serotype O viruses from the 2010 outbreak and recognised vaccine strains against serotype O FMDV<sup>1</sup>

Vaccine strain	Virus neutralization tests (VNT)						Liquid-phase blocking ELISA		
	O 3039	O 4625	O Bfs	O Ind R2/75	O Manisa	O Taw98	O BFS 1860	O Tal 189/87	O Manisa
Field isolate									
O Mong 2/2010	ND	0.33	0.05	0.43	0.10	ND	0.06	0.88	0.03
O Mong 4/2010	0.28 <sup>2</sup>	0.44	0.04	0.29	0.16	0.22	0.04	0.25	0.02
O Mong 9/2010	0,28	0.48	0.06	0.33	0.14	0.20	0.1	0.07	0.03

For VNTs  $r_1 = <0.3$  indicates that the field isolate is so different from the vaccine strain that it is unlikely to protect

For blocking ELISA  $r_1 = <0.2$  indicates that the field isolate is so different from the vaccine strain that the vaccine is unlikely to protect

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<sup>1</sup> Document supplied by the State central Veterinary Laboratory

<sup>2</sup>  $r_1$  value

## Activities undertaken by the consultant

Date	Activity
Mon 10 Jan	Departed Johannesburg for Ulaanbaatar via Dubai & Beijing
Tues 11 Jan	Arrived Ulaanbaatar at 23:00
Wed 12 Jan	Orientation at WCS office & meeting personnel
Thurs 13 Jan	Visit & discussion with Director & staff of State Central Veterinary Laboratory, Ulaanbaatar. Collection of relevant publications, reports & other publications
Fri 14 Jan	Fact finding - WCS office. Change of accommodation & other administrative arrangements. Collection of relevant publications, reports & other publications
Sat 15 Jan	Weekend
Sun 16 Jan	
Mon 17 Jan	Meeting with Director/CVO Veterinary & Animal Breeding Agency: Dr BATSUKH Zayat. Preparation for field trip
Tues 18 Jan	Flew to Chiobalsan with Dr. Enkhtuvshin Shiilegdamba. Dinner with Drs Shiilegdamba & D. Nyamsuren (Dornod Veterinary Laboratory)
Wed 19 Jan	Meeting & discussions with Director & staff of Dornod Nature, Environment & Tourism Agency, and the Dornod Mongol Special Protected Area's Park Administration and staff
Thurs 20 Jan	Meetings & discussions with the Head and other professional staff of the Veterinary Laboratory for Dornod Aimag in Choibalsan. Meeting with Director & staff of the Food & Agriculture Department of Dornod Aimag
Fri 21 Jan	Travel to Khavirga Border Post for discussion with veterinary & security officials. Trip enabled consultant to become acquainted with the countryside & see gazelles in their natural environment as well as observe border area inspection activities
Sat 22 Jan	Continue with country-side visit including Nature reserve area (Toson Khulstai) designated for gazelles & meetings & consultation with a number of herders in their gers
Sun 23 Jan	Return to Ulaanbaatar
Mon 24 Jan	Meeting with Dr LKHAGVASUREN Badaminjav - Conservation Director of WWF Mongolia Program office. Data/information gathering
Tues 25 Jan	Data/information gathering - WCS office
Wed 26 Jan	Data/information gathering - WCS office
Thurs 27 Jan	Preparation of presentations for workshop of 31 January
Fri 28 Jan	Preparation of presentations for workshop of 31 January
Sat 29 Jan	Weekend
Sat 30 Jan	
Mon 31 Jan	Participation in a consultative workshop held at the Ulaanbaatar Hotel
Tues 1 Feb	Telephone conference with Drs. Fine, Osofsky, Joly & Gilbert. Post-workshop discussion with Drs. Fine & Shiilegdamba. Consolidation of information derived from different sources, including the workshop
Wed 2 Feb	Hustai National Park; drafting of consultant's report over the Mongolian Lunar New Year holiday
Thurs 3 Feb	
Fri 4 Feb	

Sat 5 Feb	Weekend
Sun 6 Feb	
Mon 7 Feb	Drafting of consultant's report
Tues 8 Feb	Discussion session with Director & senior staff of the State Central Veterinary Laboratory. Drafting of consultants report
Wed 9 Feb	Drafting of report. Final discussion with Dr. Fine & staff of WCS office, Ulaanbaatar
Thurs 10 Feb	Depart Ulaanbaatar. Discussion with Programme Head, WCS office in Beijing
Fri 11 Feb	Arrival at Johannesburg

People and organisations consulted

- Dr Amanda Fine, Mongolia Program Director, WCS, Ulaanbaatar
- Staff of the WCS Office, Ulaanbaatar
- Dr BATSUKH Zayat  
Vice Director & Chief Veterinary Officer, Veterinary and Animal Breeding Agency, Ministry of Food Agriculture & Light industry, Ulaanbaatar
- Dr GANZORIG Khuukhenbaatar  
Director State Central Veterinary Laboratory (SCVL), Ulaanbaatar
- Dr TSERENDORJ Shaarkhuu  
Vice Director SCVL, Ulaanbaatar
- Dr SODNOMDARJAA Ruuragch  
Consultant & ex-director to the SCVL, Ulaanbaatar
- Dr Sugir Tsengee  
Head of Animal Viral Diseases, SCVL, Ulaanbaatar
- Dr GERELMAA Ulziibat  
Virologist, SCVL, Ulaanbaatar
- Dr LKHAGVASUREN Badamjav  
Conservation Director, WWF Mongolia Programme Office, Ulaanbaatar
- Mr ENKTUVSHIN Altangerel  
Director, Food & Agriculture Department, Dornod Province, Choibalsan
- Mr GANBAT Sh  
Head, Nature Environment & Tourism Agency, Dornod Province, Choibalsan
- Mr MUNKHSAIKHAN Sanjaadoo  
Head of Forest Division, Nature Environment & Tourism Agency, Dornod Province, Choibalsan
- Dr ENKHTUR Byakharjav

Project Specialist, EU Animal health & Livestock Marketing Project,  
Ulaanbaatar

- Mr TSETSENBAATAR.B  
Procurement & Marketing Officer, EU Animal health & Livestock Marketing  
Project, Ulaanbaatar
- Dr Bayarsaikhan, Head of Dornod Aimag Veterinary Agency, Choibalsan
- Dr Nyamsuren, Bacteriologist, Veterinary laboratory, Choibalsan
- Dr Zagdsuren, Parasitologist, Veterinary Laboratory, Choibalsan
- Dr Gundegmaa, Serologist, Veterinary Laboratory, Choibalsan
- Dr Yan Xie, China Program Director, WCS, Beijing
- Others: Participants in the consultation workshop held on 32 January 2011  
are shown in Appendix E



# **“Foot and Mouth Disease (FMD) in Mongolian Gazelle”**

**January 31, 2011**

**Ulaanbaatar Hotel, Urguu Hall**

**A workshop to discuss FMD epidemiology and control strategies in livestock and wildlife with participation of biology, conservation, veterinary and government professionals**

**Organized by**

**Wildlife Conservation Society (WCS)**

**Mongolia Country Program**



## Workshop Agenda

### Foot and Mouth Disease (FMD) in Mongolian Gazelle

**A workshop to discuss FMD epidemiology and control strategies in livestock and wildlife with participation of biology, conservation, veterinary and government professionals**

**Monday, Jan 31, 2011**

- 9:30 AM**      **Registration**
- 9:45 AM**      **Introduction**
- 10:00 AM**      **Opening remarks by Dr. Z. Batsukh Vice Director, CVO, Veterinary and Animal Breeding Agency, Mongolian Government Implementation Agency**
- 10:15 AM**      **Introduction to global FMD perspectives by Dr. Gavin Thomson TAD Scientific CC, WCS FMD technical consultant from South Africa**
- 10:40 AM**      **Brief introduction of FMD control strategies implemented in Mongolia by Dr. Ts. Purevkhoo, Chief epidemiologist, Veterinary and Animal Breeding Agency, Mongolian Government Implementation Agency**
- 11:00 AM**      **Tea Break**
- 11:15 AM**      **FMD diagnosis and vaccine immunization tests by Grelmaa, virologist State Central Veterinary Laboratory**
- 11:35 AM**      **Observations on FMD in Mongolia by Dr. Gavin Thomson TAD Scientific CC, WCS FMD technical consultant from South Africa**
- 12:00 AM**      **Discussion session to identify specific activities to further improve FMD prevention and control strategies**
- 12:30 AM**      **Wrap up of discussion and conclusions**
- 12:50 AM**      **Closing remarks by Dr. R. Sodnomdarjaa, consultant of the State Central Veterinary Laboratory**
- 1:00 PM**      **Lunch at UB hotel restaurant on the 1<sup>st</sup> floor**

*This workshop is made possible by the generous support of the American people through the United States Agency for International Development (USAID), under the terms of USAID/Sustainable Conservation Approaches in Priority Ecosystems Cooperative Agreement No. EEM-A-00-09-00007-00. The contents are the responsibility of the Wildlife Conservation Society and do not necessarily reflect the views of USAID or the United States Government.*

### **List of Workshop Invitees and Participants (v)**

1. J. Saule – Vice Minister, Ministry of Food Agriculture and Light Industry
2. M. Enkh-Amar – Secretary, National Emergency Committee **(v)**
3. B. Sarantsetseg – Working group member, National Emergency Committee **(v)**
4. P. Dorjsuren - Strategy Planning Agency of the Ministry of Food Agriculture and Light Industry
5. Ya. Nomkhon – Animal Husbandry Policy Planning and Implementation Agency of the Ministry of Food Agriculture and Light Industry **(v)**
6. Z. Batsukh – Vice director, Veterinary and Animal Breeding Agency **(v)**
7. Ts. Purevkhoo – Chief epidemiologist, Veterinary and Animal Breeding Agency **(v)**
8. B. Tsolmon – Veterinarian, Veterinary and Animal Breeding Agency
9. Kh. Ganzorig – Director, State Central Veterinary Laboratory **(v)**
10. D. Orgil – Deputy director, State Central Veterinary Laboratory **(v)**
11. Sh. Tserendorj – Head veterinarian, State Central Veterinary Laboratory **(v)**
12. R. Sodmondarjaa – Consultant, State Central Veterinary Laboratory **(v)**
13. U. Gerelmaa – Virologist, State Central Veterinary Laboratory **(v)**
14. B. Dashzeveg – Virologist, State Central Veterinary Laboratory **(v)**
15. S. Sugar – Virologist, State Central Veterinary Laboratory **(v)**
16. B. Sarantuya – Head of virology laboratory, Institute of Veterinary Medicine **(v)**
17. J. Bekh-Ochir – Virologist, Institute of Veterinary Medicine **(v)**
18. S. Tsogtbaatar- Head of Incidence Response Department, National Emergency Management Agency
19. B. Batsaikhan – Head of disaster protection and resource center, National Emergency Management Agency **(v)**
20. D. Turbat – Veterinary officer, National Emergency Management Agency **(v)**

21. N. Baasan – Lieutenant Colonel, Head of veterinary department, State Border Defense Agency **(v)**
22. Ts. Banzragch – Department of sustainable development and strategic planning, Ministry of Nature Environment and Tourism
23. D. Dorjgotov - Department of sustainable development and strategic planning, Ministry of Nature Environment and Tourism
24. P. Tsogtsaikhan – Department of environment and natural resources, Ministry of Nature Environment and Tourism
25. L. Amgalan – Secretary of research and science, Institute of Biology of Mongolian Academy of Sciences
26. N. Amgalanbaatar - Mammalian Ecology Laboratory, Institute of Biology of Mongolian Academy of Sciences **(v)**
27. B. Munkhtsog – Biologist at the Mammalian Ecology Laboratory, Institute of Biology of Mongolian Academy of Sciences **(v)**
28. Chuck Howell – USAID, Representative
29. Susan Russel - Economic and Environmental Officer, US Embassy **(v)**
30. N. Oyundelger –Assistant FAO representative, Food and Agriculture Organization of the United Nations **(v)**
31. B. Lhagvasuren – Conservation Director, WWF Mongolia Programme Office **(v)**
32. D. Galbadrakh – Conservation Fellow, The Nature Conservancy
33. T. Enkhjargal - Project director, Animal Health and Livestock Marketing Project **(v)**
34. B. Enkhtur – Project specialist, Animal Health and Livestock Marketing Project **(v)**
35. N. Odontsetseg – Risk free Animal Husbandry Center, NGO **(v)**
36. Gavin Thomson -WCS FMD consultant **(v)**
37. Amanda Fine – Director, WCS Mongolia Country Program **(v)**
38. Sh. Enkhtuvshin – Veterinary epidemiologist, WCS Mongolia Country Program **(v)**
39. S. Bolortsetseg – Conservation biologist, WCS Mongolia Country Program **(v)**





WCS Workshop, Ulaanbaatar:  
31 January 2011

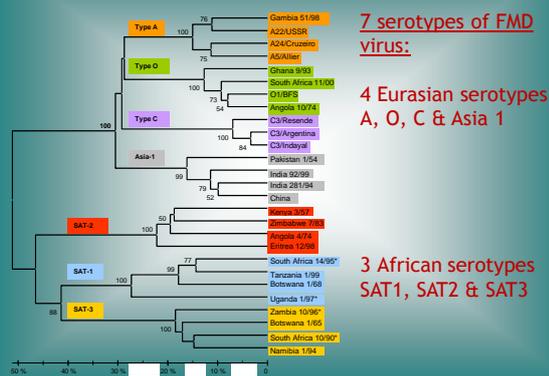
## Foot and mouth disease (FMD) and gazelles in Mongolia

Gavin Thomson, TAD Scientific CC,  
South Africa

### Issues to be covered

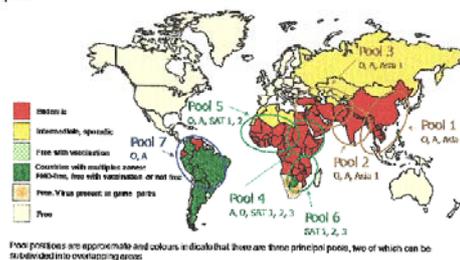
- Global FMD
  - ⇒ Two different diseases
  - ⇒ Some technical aspects/concepts concerning FMD
- FMD in wildlife
  - ⇒ Around the world
  - ⇒ Southern Africa
- FMD in Mongolia
  - ⇒ Observations on Mongolian outbreaks - what they tell us
  - ⇒ FMD management
    - Prevention of outbreaks
    - Management of outbreaks
    - Policy issues
- What knowledge gaps do we face?

### Serotypes of FMD virus



### Global distribution of FMDVs

The conjectured status of FMD in 2009 showing approximate distribution of regional virus pools:



### Two different diseases?

1. Eurasian/South American FMD
    - Serotypes O, A, C, Asia 1 (serotype C may no longer be extant)
    - Maintained & spread by domestic livestock, particularly cattle & pigs
  2. Southern African FMD
    - Serotypes SAT1-3
    - Maintained & spread principally African buffalo
    - SAT viruses may also become established in cattle
- In other parts of sub-Saharan Africa (central, eastern & western Africa) both forms of the disease/infection occur

### Species susceptible to FMD

- Potentially all cloven-hoofed animals & *Camelidae* (Artiodactyla) are susceptible to natural infection
  - At least 43 species documented as susceptible including numerous antelopes, giraffe, deer, gazelles, Indian elephants & Bactrian camels
  - But susceptibility to clinical disease & the extent of viral excretion vary with host *sp.* & virus strain

**Some concepts**

- **Maintenance (reservoir) hosts:** Single specie populations able to maintain FMDVs for long periods (years), i.e. independent of other species
- **Persistent FMDV infection:** Susceptible species in which viral replication may persist in the oro-pharynx of a proportion of individuals for >1 month
  - African buffalo: up to 5 years
  - Cattle: generally <12 months but 1 record of 43 months
  - Sheep & goats: up to 6 months
- **FMD carriers:** Persistently infected (i.e. clinically healthy animals) able to transmit the infection to susceptible individuals of the same or other species
  - i.e. able to spread the virus
  - only 1 species (African buffalo - *Syncerus caffer*) shown to be able to do that

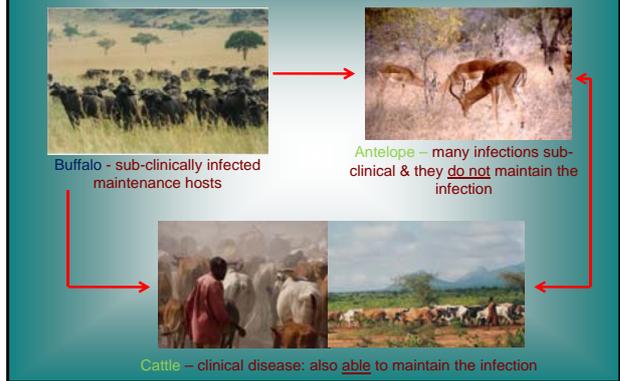
**Persistent infection/carriers- examples**

Species	Susceptibility	Persistent infection	Maintenance hosts	Evidence for carrier trans.
African buffalo	++++	+++	++++	+
Cattle	++++	++	+++	-?
Pigs	+	-	++	-
Sheep	++	++	+	-
Impala	+++	-	-	-
Kudu	++	+	-	-
Fallow deer	++	+	-	-
Sika deer	++	+	-	-
Roe deer	++	-	-	-
Mongolian gazelle	++	?	?	?

**SAT-virus serotypes & African buffalo**

- SAT viruses adapted to persistence in African buffalo (*Syncerus caffer*) populations
- In general, where buffalo occur in southern Africa, SAT-serotype viruses are endemic
- In endemic situations, sub-clinical infection of young buffalo occurs before they are 12 months old & during the acute phase of the infection they excrete large amounts of virus
- >50% of infected buffalo become potential carriers, i.e. may transmit to other buffalo or cattle
  - However, FMD transmission to cattle is inefficient!
  - Transmission mainly by infected calves within breeding herds (i.e. not carriers)

**FMD in southern Africa**





But >75% of impala infections with SAT viruses result in no clinical disease – so disease surveillance is insensitive!

- supporting serology is necessary (Vosloo *et al.*, 2009)

### Control of FMD in southern Africa

Four pillars of FMD control in southern Africa:

- Separation of buffalo & cattle populations – usually with agency of fences
- Routine & regular vaccination of cattle populations in the vicinity of buffalo
- Continuous intensive surveillance of cattle populations – weekly inspection in high risk areas
- Management of the movement of domestic livestock & animal products
  - but use of fences is increasingly problematic!

### Fencing of DFZs in southern Africa



South Africa



Zimbabwe

### Conflict between livestock development & conservation initiatives

- Livestock development is based on separating disease-free animal populations from those that serve as reservoirs of FMD viruses ⇒ access to international markets
- Bio-diversity conservation is based on maintaining the 'connectedness' between animal & plant populations
- Result is fundamental conflict in respect of rural development
- We are developing ways that enable bio-diversity conservation & livestock development to be more compatible in the same general area

### Transfrontier conservation area (TFCA) initiative



- Patchwork of interconnected TFCAs
- Incompatible with expansion/development of FMD-free zones

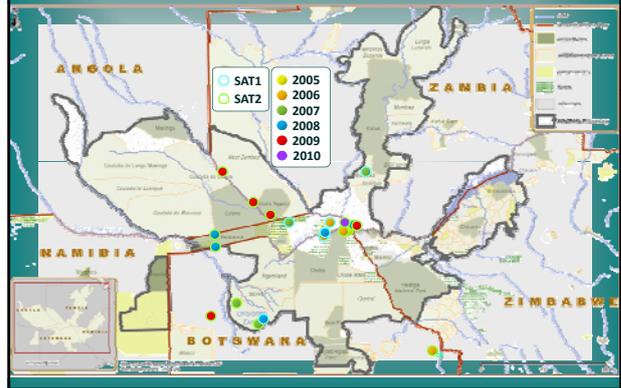
### The Kavango-Zambesi (KAZA) TFCA

• Home to about 1.2 million people, their livestock & large wildlife population (buffalo numbers increasing) in an area the size of Italy

• Most outbreaks of FMD in southern Africa since 2005 have been in & around KAZA TFCA due to increased wildlife-livestock interaction



### SAT OUTBREAKS IN THE KAZA TFCA

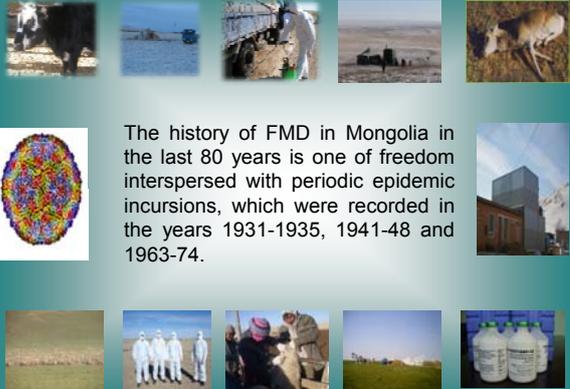




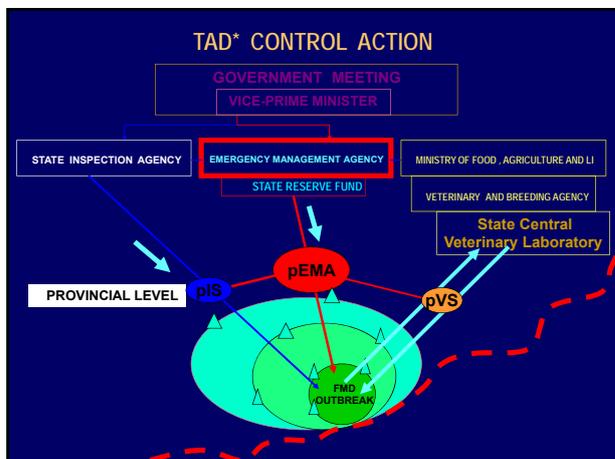
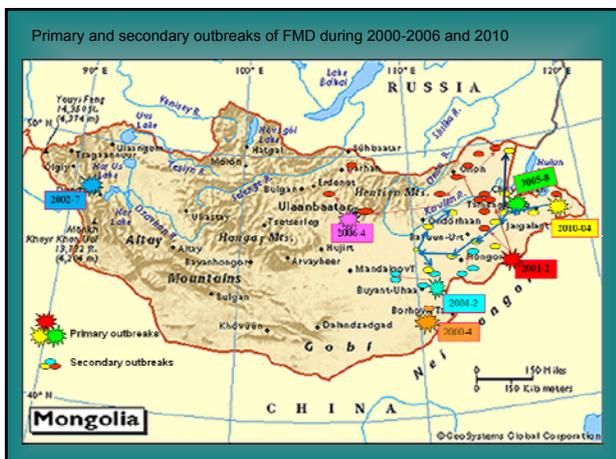
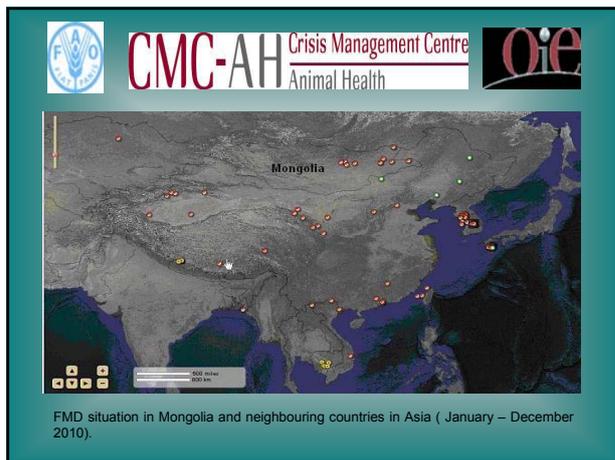
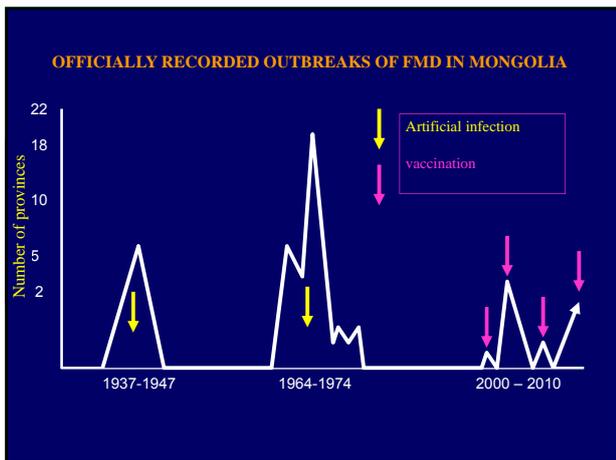
**Brief introduction of FMD control strategies implemented in Mongolia**

**Ts. Purevkhuu**  
 Chief epidemiologist, Veterinary and Animal Breeding Agency, Mongolian Government Implementation Agency

“Foot and Mouth Disease (FMD) in Mongolian Gazelle” workshop  
 ULAANBAATAR  
 31 January, 2011



The history of FMD in Mongolia in the last 80 years is one of freedom interspersed with periodic epidemic incursions, which were recorded in the years 1931-1935, 1941-48 and 1963-74.



**TAD CONTROL MANAGEMENT AND RESOURCE****Veterinary Service, MoFA**

- Disease diagnosis and confirmation
- Work out control strategies in accordance with OIE rules and specificity of livestock husbandry system at different geographical zones
- Implementation of control measures

**Emergency Management Agency**

- Harmonize all control actions in line with MoFA and SSIA guidance
- Mobilize forces of military, police and civil contingency
- Assign required funds for control
- Assist local authorities in disease control activities

**State Specialized Inspection Service**

- Issue degree of designating the quarantine zones
- Inspection over implementation of control measure

**FMD control strategy****Creation of Control zone**

This includes outbreak zone, buffer zone, vaccination zone, and healthy zone

**Quarantine activities**

Control and quarantine of livestock, livestock products, human and traffic movements

**Stamping out (optional)**

The compensation for stamping out is calculated to equal 90% of the livestock market price

**Vaccination:** Force vaccination without any fees

**Other activities:** Training and awareness raising, interdepartmental collaboration and preparedness

**Timing and number of FMD outbreaks from 2000-2010.**

Year/month	2000	2001	2002	2004	2005	2006	2010
January							
February		19		13			
March		4		5			
April	1	1		2		1	1
May	1	1					1
June							1
July			3				
August					1		2
September							11
October							2
November							6
December							
<b>TOTAL</b>	<b>2</b>	<b>25</b>	<b>3</b>	<b>20</b>	<b>1</b>	<b>1</b>	<b>24</b>

Эх үүсвэр: МЭҮГ, ОБЕГ

**Number of culled livestock for FMD during outbreaks in 2000-2010**

Years	Province	Soum	Herding household	Total number of susceptible livestock in outbreak zone	Number of culled livestock	Expenses for compensation (thousand tugrug)
2000	1	2	91	22,948	916	48,456.0
2001	6	16	496	760,915	1,201	96,720.0
2002	2	3	166	20,704	485	36,804.0
2004	3	8	374	90,804	2,317	254,325.0
2005	1	1	37	15,779	235	17,700.0
2006	1	1	1	24	24	774.0
<b>2010</b>	<b>6</b>	<b>24</b>	<b>1,078</b>	<b>465,285</b>	<b>25,933</b>	<b>2,494,500.0</b>
<b>Sum</b>	<b>20</b>	<b>55</b>	<b>2,243</b>	<b>1,376,459</b>	<b>31,111</b>	<b>2,894,200.0</b>

Эх үүсвэр: МЭҮГ, ОБЕГ, УОК

**Number of culled livestock, by species (2000-2010)**

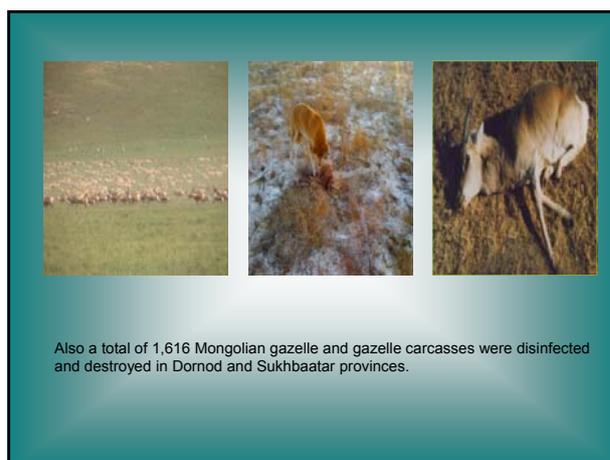
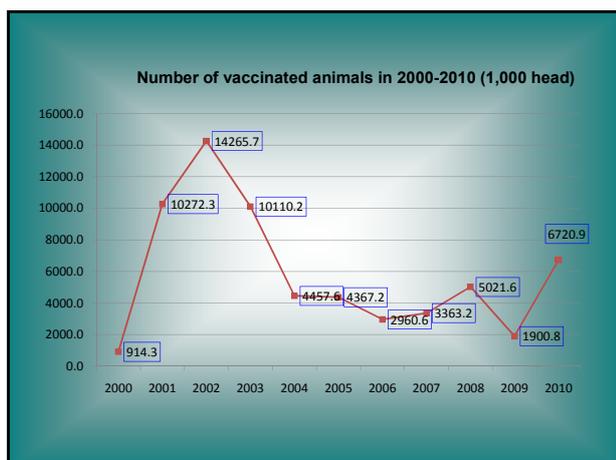
Year	Camel	Cattle	Sheep	Goat	Pig	Total
2000	54	552	152	158	0	916
2001	4	1159	16	20	2	1201
2002	0	435	46	4	0	485
2003	0	0	0	0	0	0
2004	0	2072	157	88	0	2317
2005	0	186	28	21	0	235
2006	0	4	20	0	0	24
<b>2010</b>	<b>10</b>	<b>6730</b>	<b>13495</b>	<b>5698</b>	<b>0</b>	<b>25933</b>
<b>Sum</b>	<b>68</b>	<b>11138</b>	<b>13914</b>	<b>5989</b>	<b>2</b>	<b>31092</b>

Эх үүсвэр: МЭҮГ, ОБЕГ

**Immunization of susceptible species in 2000-2010 (1,000 head)**

Year	Province	Soum	Camel	Cattle	Sheep	Goat	Pig	Young animals	Total
2000	1	11	32.4	75.9	430.8	375.3	0.0	0.0	914.3
2001	11	102	95.2	1377.1	5812.4	2801.1	16.2	170.3	10272.2
2002	13	104	158.9	1446.2	7459.0	5022.4	23.7	155.5	14265.7
2003	10	85	143.5	814.9	4226.0	3896.9	4.1	1024.7	10110.1
2004	9	75	54.1	340.0	2627.4	1436.0	0.1	0.0	4457.6
2005	10	61	99.9	295.3	1839.1	2133.0	0.0	0.0	4367.2
2006	6	64	108.4	433.9	1472.8	943.1	24.6	0.0	2982.8
2007	6	65	140.5	426.1	1577.1	1211.3	8.2	0.0	3363.2
2008	8	72	104.6	454.5	2152.6	2310.0	0.0	0.0	5021.7
2009	4	49	93.3	299.3	584.8	583.3	0.0	0.0	1560.7
<b>2010</b>	<b>7</b>	<b>71</b>	<b>28.1</b>	<b>506.3</b>	<b>3,583.6</b>	<b>2,601.4</b>	<b>1.6</b>	<b>0.0</b>	<b>6,720.9</b>
<b>Total</b>	<b>85</b>	<b>759</b>	<b>1,058.8</b>	<b>6,469.4</b>	<b>31,765.3</b>	<b>23,313.8</b>	<b>78.53</b>	<b>1,350.53</b>	<b>64,036.4</b>

Source: by 30.Dec, 2010 DVAB



WAHID Interface Animal Health Information Information зооноотар Information Zoonotaria

oie

Country	Date of Notification	Disease	Reason for Notification	Disease manifestation	Outbreaks	Date resolved
Mongolia	05/05/2010	Foot and mouth disease	Reoccurrence	Clinical disease	3	11/08/2010
Mongolia	01/09/2010	Foot and mouth disease	Reoccurrence	Clinical disease	6	Continuing
Mongolia	10/05/2010	Highly path. avian influenza	Reoccurrence	Clinical disease	1	14/06/2010
Mongolia	01/09/2010	Newcastle disease	Reoccurrence	Clinical disease	1	22/09/2010



### Costs associated to 2010 FMD outbreak control activities

As of December, 12 2010 (mill tugriks)

Activities costs	Vehicles (2 disinfection compressors, 3 Russian jeeps)	PPE	Vaccination and administration costs	Disinfection chemicals	Compensation
440.6	145.5	60.0	2,500.0	60.0	2,494.5

Эх үүсвэр: МЭУГ, ОБЕГ, УОК

### International donations and consulting activities

No	International organizations and funds	Amount of funding (thousand US dollars)	Purpose of fund
1	USAID and WCS	30.0	For FMD vaccine purchase
2	International Atomic Energy Agency	98.0	For FMD vaccine purchase 200,000 dosage
3	Government of Japan	101.5	For FMD vaccine purchase
4	Government of Japan	101.7	For FMD vaccine purchase
5	Government of Japan		Consulting
6	UN- FAO		Consulting

2010.12.30 өдрийн байдлаар 331,2 мянган ам доллар

**Монгол улсад бүртгэлтэй шүлхийн вакцин**

№	Нэр	Үйлдвэрлэгч орон	Бүртгэлийн дугаар
1	Хөнгөн цагааны усан исэлт, идэвхгүйжүүлсэн вакцин 1 (O, A, N, Asia 1, NAO-1,2,3)	БОМАЭМХХ, ОХУ	089
2	Тосон хүчлүүртэй, идэвхгүйжүүлсэн вакцин O, A, Asia-1, AFTOVAXPUR,	Мериал, Франц	0180
3	Хөнгөн цагааны усан исэлт, идэвхгүйжүүлсэн вакцин 2 болон 3 цэнт, AFTOVAX	Казакстан	0181
4	Хөнгөн цагааны усан исэлт, идэвхгүйжүүлсэн вакцин 1	БНХАУ	0267
5	Тосон хүчлүүртэй, идэвхгүйжүүлсэн вакцин O, A, Asia-1	Энэтхэг	0223
6	Тосон хүчлүүртэй, идэвхгүйжүүлсэн вакцин O, A, Asia-1	БОМАЭМХХ, ОХУ	0359

Эх үүсвэр: МЗҮГ, ХХААХҮЯ

### Vaccination strategy



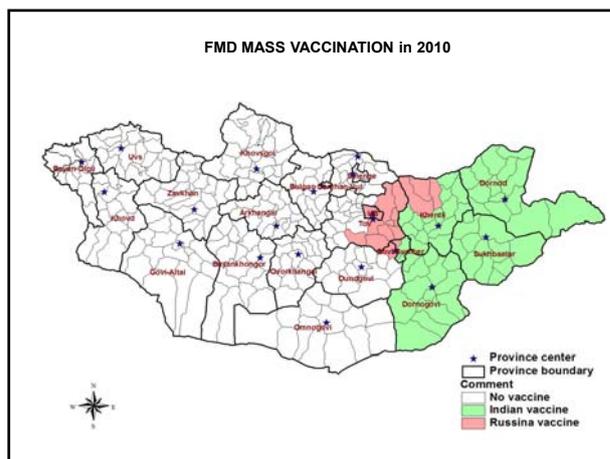
1. To vaccinate livestock from high risk soums and neighboring soums (including livestock that are lost and wandering in the area, herder families on move, organization livestock etc.);
2. Use vaccines only registered by the Mongolian pharmaceutical registry
3. Use bi or trivalent vaccines /A,O,Asia-1/, if necessary to use monovalent vaccine produced by a field strain
4. Vaccination should be directed from healthy zone to suspect and outbreak zones in circular motion directed from outskirts to the center, but stamping out is directed from outbreak zone to healthy zone;
5. **Same vaccine should be administered to all susceptible livestock of a soum, district, and aimag.**
6. All susceptible livestock, and offspring in the area must be immunized ;
7. After the vaccination serology tests will be implemented for vaccine immunization evaluation and monitoring;
8. Vaccination costs should consider the coverage of vaccination immunization monitoring as well when allocated to the VABA;

**Mass vaccination in 2010**

Province	Soum	Camelidae	Cattle	Goats	Sheep	Swine	Total	%
1 Khentii	15	3,640	108,415	630,912	852,403	600	1,595,970	97.8%
2 Dornod	14	6,179	120,287	360,686	637,573	556	1,125,281	100%
3 Dornogovi	7	5700	19641	243226	281257	15	549,839	100%
4 Tov	10	1077	51279	305,474	482,081	363	840,274	100%
5 Ulaanbaatar	9	166	63,065	127,144	158,254	0	348,629	100%
6 Sukhbaatar	13	10,605	139,735	843,405	1,095,572	0	2,089,317	94.4%
7 Govisumber	3	712	3850	90560	76432	0	171,554	100%
	<b>71</b>	<b>28,079</b>	<b>506,272</b>	<b>2,601,407</b>	<b>3,583,572</b>	<b>1,534</b>	<b>6,720,864</b>	



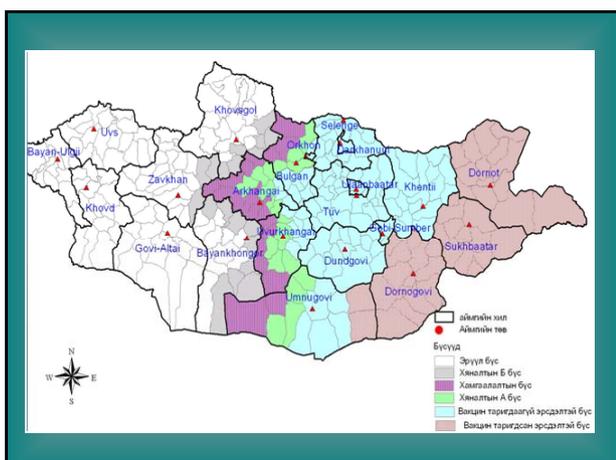
Source: DABA, 31, Dec, 2010



**FMD vaccine immunization results**

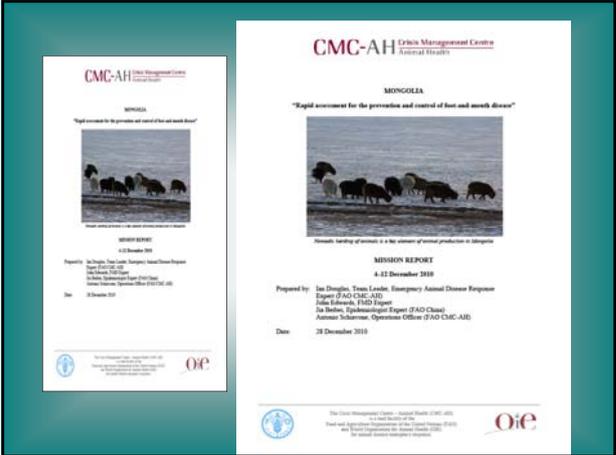
Animal species	Serum samples tested	Number of pos samples, %					
		O serotype	%	A serotype	%	Asia-1 serotype	%
<b>Dornod</b>							
	93	90	97%	63	68%	62	67%
<b>Khentii</b>							
	137	131	96%	109	80%	87	64%
<b>Norivlon (vaccinated in June)</b>							
Үхэр	10	2	20%	0	0%	1	10%
<b>Sukhbaatar</b>							
	62	43	69%	28	45%	8	13%
<b>Dornogobi</b>							
	81	76	94%	56	69%	61	75%

A total of 1,092 people, 184 vehicles, 55 motorcycles, 82 control and disinfection points, and 79 mobile posts were active (as of 24 Nov, 2010)



- ### Lessons learned
- Structure
  - Rapid response capability
  - Emergency response activity funds (vaccination, PPE, disinfecting materials, budget)
  - To ensure professional capabilities and availability
  - Trainings and awareness raising activities

- ### Future efforts
- Conduct survey to ensure that vaccinations are effective
  - A second round of vaccinations in the Spring, where previously vaccinated in necessary
  - Decide what Mongolia's future targets are – free overall, protect high risk areas



**Thank you for your attention!**

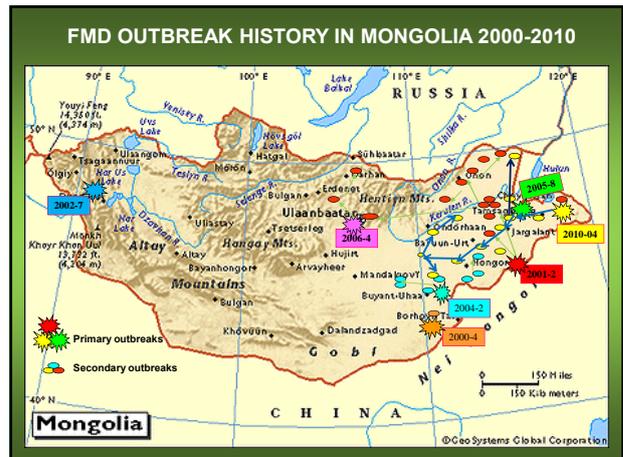
STATE CENTRAL VETERINARY LABORATORY



## FOOT AND MOUTH DISEASE IN MONGOLIA

U.GERELMAA B. DASHZEVEG, S.SUGAR,  
SH.TSERENDORJ, R.SODNOMDARJAA KH.GANZORIG

STATE CENTRAL VETERINARY LABORATORY  
MONGOLIA  
31 JANUARY, 2011



### New cases of FMD in Mongolia



**In cattle clinical symptoms were most clear**

**Symptoms were mostly noted in the mouth**

### FMD in Cattle

*Bulgan soum of Dornod Province*



*Ruptured vesicles on cattle tongue*      *Cattle tit vesicles*

*Т. Жамъяндорж*      *Г. Сумъяа*

### FMD in Camel



The epidermis layer on the feet and chest sloughed off and the animal often laid down on its side due to the chest and feet injuries

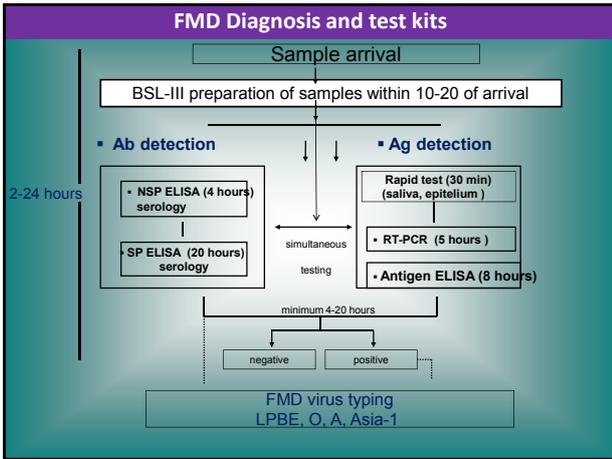
### FMD in Gazelle



**White tailed gazelle-  
*Procapra gutturosa*  
(approx. 5.7 million in 2010)**

During the FMD and other severe infection, infected herd migrate faster, changing normal direction, leaving sick one

*Procapra gutturosa* (Pallas, 1777)



### EQUIPMENT AND DIAGNOSTIC KIT

**Ag and Ab LPB-ELISA** - IAH, PIRBRIGHT, UK  
**NSP ELISA** - CHEKIT, PERONICS, JBT  
**PCR PRIMERS** - INVITROGEN, USA

### FMDV RNA detection by rapid test

SVANOVA DIP FMDV-Ag TEST  
 Sp 99.5%  
 Sn 83.7%

*Results: FMD detected from gazelle saliva from Matad soum of Dornod province.*

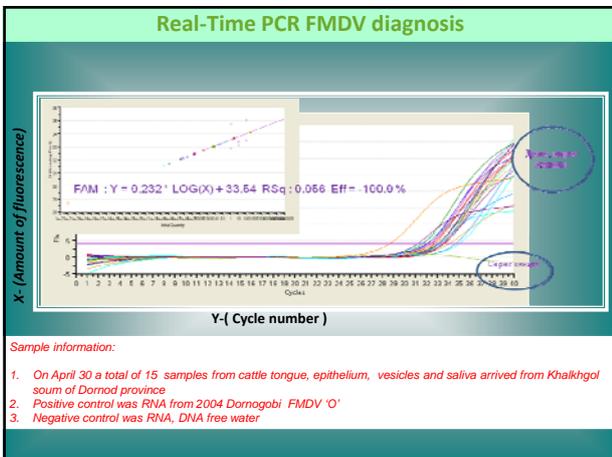
### Real Time PCR detection of FMDV specific gene

390 bp  
190 bp

1 2 3 4 5 6 7 M 9 10 11 12 13 14 15 16 17 18

*Samples: cattle, camels, gazelle tissue samples from Khalkhgol, Choibalsan, Kherlen soums of Dornod, Sukhbaatar, Erdenetsagaan soums of Sukhbaatar provinces*

Positive control RNA sample from Dornogobi 2004, 'O'	cattle	Tongue tissue
Positive control RNA sample from Dornod 2005, 'Asia-1'	cattle	Tongue tissue
Negative control, Ulaanbaatar Meat Market	cattle	Tongue tissue



### Results of serology tests

No	Animal Species	3ABC Chekit-ELISA			3AB Jenbiotech-ELISA			O Jenbiotech-ELISA			O LPBE-ELISA		
		tested	positive	%	tested	positive	%	tested	positive	%	tested	positive	%
1	Cattle	284	140	49.3%	74	30	40.5%	26	19	73.0%	56	31	55.3%
2	Sheep	213	57	26.7%	-	-	-	26	5	19.2%	30	4	13.3%
3	Goat	51	16	31.4%	-	-	-	4	-	0%	12	1	3.33%
4	Camel	15	3	20%	-	-	-	-	-	-	-	-	-
5	Gazelle	128	64	59.2%	14	-	0%	30	20	66.6%	-	-	-
<b>Total</b>		<b>671</b>	<b>280</b>	<b>41.7%</b>	<b>88</b>	<b>30</b>	<b>34.9%</b>	<b>86</b>	<b>44</b>	<b>42.8%</b>	<b>98</b>	<b>36</b>	<b>36.7%</b>



### Sample collection practice/process/procedure



Chasing of gazelle



Throat muscle collection



Blood collection

*State Central Veterinary Laboratory, Mongolia*

### FMD infection surveillance in Gazelles (35 samples)

	Tests	Results	Typing
Ab detection	NSP-ELISA (3ABC) (Cediagnostics, The Netherlands)	1 pos (sample # 8)	O
	LPB-ELISA (Pirbright, UK)	1 pos (sample # 8)	O
RNA detection	RT-PCR (Intron, Korea)	neg	

All sera from the gazelles were tested by FMDV NSP ELISA (Ceditest-NSP) and FMDV Ab detection ELISA (LPB, Pirbright, type O, A and Asia 1). One sera (number 8) was positive on both tests (the animal was a 4 year old female). PCR RT-PCR test results demonstrated that all samples were negative in the.

*State Central Veterinary Laboratory, Mongolia*

### FMD infection surveillance in Gazelles, September 2010

❖ Detected FMDV gene from 8 (57.1%) samples out of 14 gazelles and FMDV antibody from 11 serum out of 14 gazelle samples collected from Sukhbaatar soum of Sukhbaatar and Matad soum of Dornod provinces, respectively.

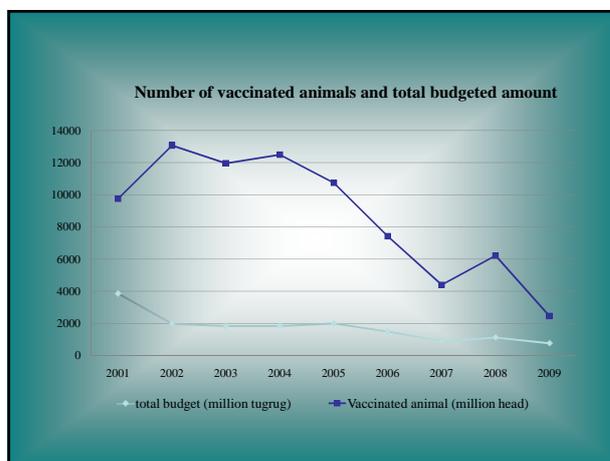


### FMD infection surveillance in Gazelles, November 2010

Provinces	Soums	Local name	Clinical signs	Real time PCR result	NSP ELISA results	Sex	Age	Sample collection date
Tuv	Bayantsagaan	Dov	no	negative	negative	M		32010.11.13
Tuv	Bayantsagaan	Dov	no	negative	negative	F		32010.11.13
Dundgovi	Tsagaandelger	Sumiin oir	no	positive	negative	M		42010.11.14
Tuv	Bayantsagaan	Onkh	no	positive	negative	M		52010.11.15
Tuv	Bayantsagaan	Onkh	no	negative	negative	M		42010.11.17
Tuv	Bayantsagaan	Onkh	no	positive	negative	M		32010.11.17
Tuv	Bayantsagaan	Dov	no	positive	negative	M		32010.11.18
Tuv	Bayantsagaan	Dov	no	positive	negative	M		52010.11.18
Tuv	Bayantsagaan	Dov	no	positive	negative	F		22010.11.18
Khentii	Darkhan	Ulaan undur	no	negative	positive	F		32010.11.21
Khentii	Darkhan	Ulaan undur	no	negative	negative	F		32010.11.21
Khentii	Darkhan	Ulaan undur	no	negative	negative	F		42010.11.21
Khentii	Darkhan	Ulaan undur	no	negative	negative	F		22010.11.21
Khentii	Darkhan	Ulaan undur	yes	positive	negative	M		32010.11.21
Khentii	Darkhan	Ulaan undur	yes	positive	positive	F		42010.11.21
Khentii	Darkhan	Bor undur	no	positive	positive	F		22010.11.21
Dornogovi	khkhhet		no	positive	positive	F		32010.11.22
Dornogovi	khkhhet		no	positive	positive	F		42010.11.22
Dornogovi	khkhhet		no	positive	positive	M		22010.11.22
Dornogovi	khkhhet		no	positive	positive	M		22010.11.22
Dornogovi	Altanshiree	Har teeg	no	positive	capser	F		22010.11.23
Dornogovi	Altanshiree	Har teeg	yes	positive	capser	F		12010.11.23
Sukhbaatar	Tumuntsogt		no	positive	capser	F		32010.11.26

### FMD Vaccines Registered in Mongolia

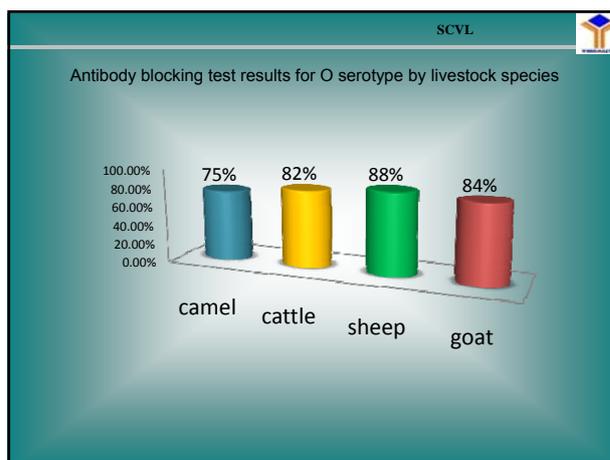
#	Vaccine name	Manufacturer	Serotypes	Registration #
1	Inactivated aluminium hydroxide multi valent vaccine	Russian, ARIAH	O, A, N, Asia-1, SAO-1,2,3	089
2	Oil emulsion trivalent vaccine AFTOVAXPUR	French, Merial	O, A, Asia1	180
3	Bi and trivalent vaccine, AFTOVAX	Kazakistan	O, A and O, A, Asia1	181
4	Inactivated aluminium hydroxide monovalent vaccine	China	I	267
5	Raksha Ovac oil adjuvant trivalent vaccine	Indian Immunologicals	O, A, Asia-1	223
6	Oil adjuvant trivalent vaccine	Russian, ARIAH	O, A, Asia-1	359



**SCVL**

Vaccine immunization results after 2 months from vaccination

A/A	Province	soum	serotype	tested	positive	%
1	Dornod Pi=72.3%	7	O	150	133	89%
			A	150	105	70%
			Ази-1	150	87	58%
2	Khentii Pi=71.3%	4	O	137	121	88%
			A	137	97	71%
			Ази	137	75	55%
3	Dornogobi Pi=67%	11	O	258	194	75%
			A	258	164	64%
			Ази	258	161	62%



**SCVL**

Table 2. By animal species

A / A	Province	serotype	camel			cattle			sheep			goats		
			tested	+	%	tested	+	%	tested	+	%	tested	+	%
1	Dornod Pi=72.3%	O	10	9	90%	79	73	92%	30	30	100%	21	21	100%
		A	10	2	20%	79	61	77%	30	25	83%	21	17	81%
		Ази-1	10	4	40%	79	50	63%	30	19	63%	21	14	67%
2	Khentii Pi=71.3%	O	10	8	80%	47	37	79%	41	40	98%	39	36	92%
		A	10	7	70%	47	34	72%	41	29	71%	39	27	69%
		Ази	10	2	20%	47	24	51%	41	22	54%	39	27	69%
3	Dornogobi Pi=67%	O	52	37	71%	95	71	75%	50	36	72%	61	45	74%
		A	52	30	58%	95	65	68%	50	23	46%	61	38	62%
		Ази	52	27	52%	95	69	73%	50	35	70%	61	39	64%

**FMD Vaccine Matching Strain Differentiation Report**

Report no.	VNT							LPBE			
	VNT	O 3039	O 4625	O Bfs	O Ind R2/75	O Manisa	O Taw98	LPBE	O BFS 1860	O Tai 189/87	O Manisa
Vaccine:											
Field isolate:											
O Mog 3/2010	Mean	<b>ND</b>	0.33	0.05	0.43	0.10	<b>ND</b>	Mean	0.06	0.88	0.03
O Mog 4/2010	Mean	0.28	0.44	0.04	0.29	0.16	0.22	Mean	0.04	0.25	0.02
O Mog 9/2010	Mean	0.28	0.48	0.06	0.33	0.14	0.20	Mean	0.1	0.07	0.03

*In the case of Virus Neutralisation Test (VNT):*  
 $r_1 \geq 0.3$ : Suggests that there is a close relationship between field isolate and vaccine strain. A potent vaccine containing the vaccine strain is likely to confer protection.  
 $r_1 < 0.3$ : Suggests that the field isolate is so different from the vaccine strain that the vaccine is unlikely to protect.  
 ND = Not done.

*In the case of Liquid Phase Blocking Elisa (LPBE):*  
 $r_2 \geq 0.4-1.0$ : Suggests that there is a close relationship between field isolate and vaccine strain. A potent vaccine containing the vaccine strain is likely to confer protection.  
 $r_2 = 0.2-0.39$ : Suggests that the field isolate is antigenically related to the vaccine strain. The vaccine strain might be suitable for use if no closer match can be found provided that a potent vaccine is used and animals are preferably immunised more than once.  
 $r_2 < 0.2$ : Suggests that the field isolate is so different from the vaccine strain that the vaccine is unlikely to protect.  
 DNT = Did not trap.  
 ND = Not done.

Thank you very much

STATE CENTRAL VETERINARY LABORATORY  
 MONGOLIA  
[www.scvl.gov.mn](http://www.scvl.gov.mn)



WCS Workshop, Ulaanbaatar:  
31 January 2011

## Epidemiology & control of FMD in Mongolia

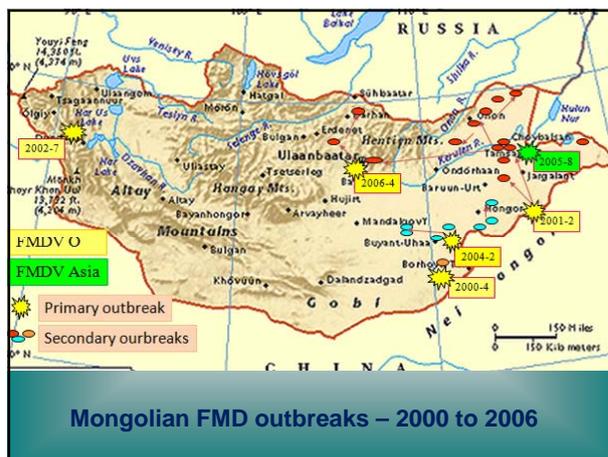
Gavin Thomson, TAD Scientific CC,  
South Africa

## Important issues

- Policy frame-work
  - Is Mongolia's desire to increase production & improve access to international animal commodity/product markets appropriately supported by the FMD strategy?
  - Environmental implications
- Important factors:
  - What does the recent epidemiology of FMD in Mongolia tell us?
  - Strategy to prevent future FMD outbreaks - could it be improved?
  - Effective control of outbreaks when they do occur - is improvement possible?
    - including more appropriate trade- & eco-friendly strategies

## Mongolian FMD outbreaks: 2000-2010

Date	Initial outbreak location (Aimag)	Type	Spread	Vaccinated population	Gazelle involvement
April-? 2000	Dornogobi	O	Limited	No	No
Feb-May 2001	Sukhbaatar	O	Extensive	No	Yes
July-? 2002	Khovd/Bayan-Ulgii	O	Limited	No	N/A
Feb-April 2004	Dornogobi	O	Significant	Yes	Yes
Aug-Oct 2005	Dornod	Asia 1	Limited	Yes	No
April 2006	Tuv	O	None	No	N/A
April-(Sept) Dec 2010	Dornod	O	Significant	Yes	Yes



## Summary of FMD occurrence in Mongolia (2000-2010)

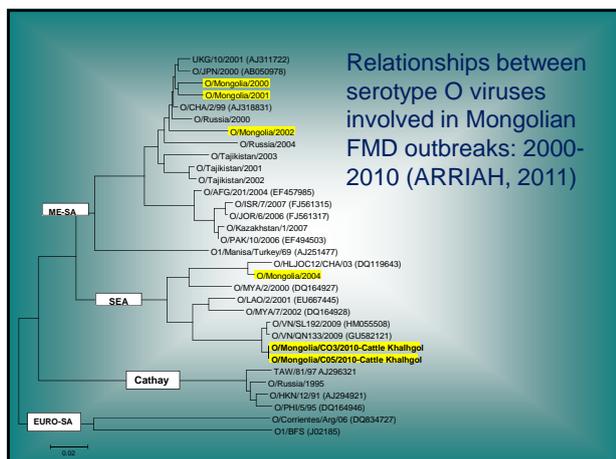
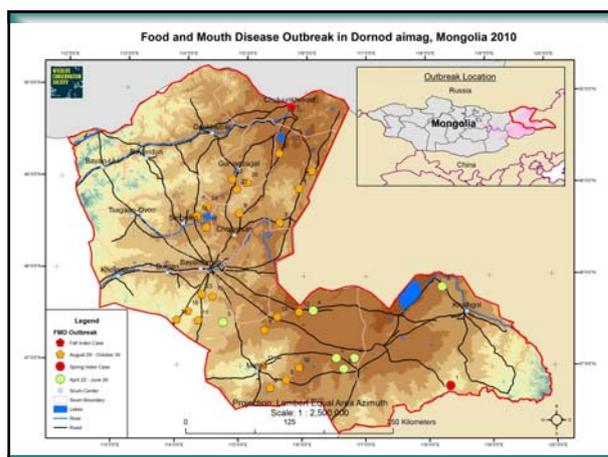
- 6/7 outbreaks caused by O viruses (one Asia 1)
- 5/7 outbreaks started on the eastern Steppe close to Chinese border
- 3 of these 5 outbreaks involved gazelles
  - gazelles infected 1<sup>st</sup> in 2004 outbreak (Sodnomdarjaa *et al.*, 2007); apparently not in 2001 & 2010
- 2000/2001 outbreak viruses closely related (Sodnomdarjaa *et al.*, 2007)
  - part of the Pan-Asia O Pandemic (including intercontinental spread to UK & South Africa) that originated in northern India in 1990
  - 2000 isolate had ~98% homology with 1999 Chinese isolate (CHA/4/99 - Qian Feng *et al.*, 2003)
  - one or two introductions to Mongolia?

## Summary of FMD occurrence in Mongolia - 2000-2010 (cont.)

- 2002 outbreak virus in Hovd/Bayan-Ulgii closely related to 2000/2001 viruses
  - also therefore part of the Pan-Asia O pandemic
  - cross-country spread or separate introduction?
- 2004 outbreak caused by significantly different O viruses to 2000-2002 outbreaks (SEA toptotype)
  - clinical disease was detected in gazelles before livestock (Sodnomdarjaa *et al.*, 2007)
  - closely related to 2003 Chinese isolate (IAH, 2010)
- 2005 Asia 1 outbreak part of an Asian pandemic (Valarcher *et al.*, 2009)
  - gazelles apparently not affected
- 2006 O outbreak - no sequence data available

## Summary of FMD occurrence in Mongolia - 2000-2010 (cont.)

- All 2010 outbreak viruses closely related within the SEA topotype, i.e. only distantly related to 2004 outbreak viruses
  - O outbreak in China started Feb 2010, i.e. before April Mongolian outbreak commencement
  - subsequent Russian O outbreak (July) - caused by closely related virus - spread from China (OIE website)?
  - Mongolian 2010 serotype O isolates from livestock & gazelles were closely related
  - outbreak had 2 phases, i.e. in spring & autumn
  - spring outbreak on Chinese border; autumn - Russia
  - possibly autumn outbreak re-imported from Russia by gazelles returning across Russian border



Relationships between serotype O viruses involved in Mongolian FMD outbreaks: 2000-2010 (ARRIAH, 2011)

## What can we safely conclude?

- FMD outbreaks have:
  - usually been extensions of livestock-associated Asian pandemics (e.g. 2000/1/2; 2005; 2010)
  - these pandemic viruses did not persist
  - therefore, FMD is not endemic to Mongolia (accepted internationally!)
  - but Mongolia has a high-risk area - eastern Steppe
- How did FMDVs enter the country?
  - unknown but unlikely - other than in case of 2004 outbreak - to have been via gazelles because the incursions were mostly extensions of livestock-associated Asian pandemics
  - few gazelles enter Mongolia from China (fences & Chinese/Mongolian border policies)

## What can we safely conclude? (cont.)

- Once FMD occurs on eastern Steppe, do gazelles contribute to spread of the infection?
  - answer unknown
  - but, pending further investigation, it should be assumed that they are capable of spreading the infection
  - although, they are likely to be less effective spreaders than cattle
- The issue of 'carriers' (for both livestock & gazelles) can, for practical purposes, be ignored unless new data is provided that shows that this assumption is incorrect
  - Mongolia/others may decide to follow this up through experimentation - difficult & unrewarding!

## Management of FMD in Mongolia

### Outbreak prevention

- On eastern Steppe animal movement is uncontrolled except for border fencing & policing
- Vaccination (creation of continuous high level of herd immunity) of livestock is vital (cattle esp.)
  - But vaccination has so far been intermittent & for that reason has been insufficiently effective
- Adequate herd immunity can only be ensured by application of a systematic programme (preferably with regular independent auditing)
- The issue of virus strains incorporated into the vaccine employed is also vital (covered later)

### FMD outbreak management

- FMD outbreak management in Mongolia is founded on 5 basic activities:
  - isolation of the outbreak focus with establishment of suspicion & protection zones around it
  - elimination of clinically diseased animals, including susceptible wildlife (i.e. modified stamping out - MSO)
  - vaccination of clinically normal animals not destroyed
  - 2-3 rounds of disinfection
  - maintenance of quarantine for 3 weeks after vacc.
- MSO has some inherent problems :
  - significant numbers of most species become infected & excrete virus without developing disease or have only mild lesions that are difficult to detect (sheep & goats – possibly gazelles also)

### FMD outbreak management (cont.)

- in extensive systems (e.g. southern Africa - probably Mongolia), spread of FMDVs within infected herds is frequently slow – presents a logistical difficulty
- detection of clinically infected gazelles is very inaccurate, i.e. a hit-and-miss activity
- The question is, why is MSO essential?
  - presumably to prevent development of FMD carriers
  - but there is no objective evidence that carrier livestock or gazelles occur in any case
- MSO also has clear negative effects
  - upsets herders & disrupts livestock production
  - promotes migration & contributes to the decline of the gazelle population of the eastern Steppe
  - expensive for the Government

### FMD outbreak management (cont.)

- In 2010 outbreak, vaccination used in the control of the outbreak proved less than satisfactory
  - not a new experience
- Shown retrospectively that 2010 outbreak viruses were poorly matched with the O<sub>1</sub> Manisa vaccine strain in the vaccine (IAH [UK], 2011)
  - demonstration of how important it is to ensure that vaccines purchased to prevent or manage outbreaks are selected to match known or likely field FMDVs
  - more important than the price of vaccine!
- Could a different strategy be employed?
  - possibly

### Possible future approach to FMD vaccine content

- Because the major threat to Mongolia is clearly posed by serotype O viruses it may be worthwhile in the immediate future to concentrate on good coverage against O subtypes prevalent in SEA
  - e.g. inclusion of two or more O vaccine strains representing different O subtypes
  - this decision should be reached through discussion with one or more appropriate FMD reference laboratories
  - southern African countries use this approach

### FMD policy in Mongolia

### FMD-free zones

- It is understood that Mongolian authorities are considering a future zoning approach that comprises 5 zones
  - while potentially sound, the proposed plan seems overcomplicated
  - it is suggested a simpler plan should be considered
- FMD management in relation to trade is complex - insufficient time to deal with this issue today
  - sanitary & phyto-sanitary measures are only one of the issues needing consideration

### Knowledge gaps/ areas for possible reconsideration

### Suggestions

- Technical issues
  - Re-evaluation of selection criteria/processes for vaccine strains used in routine prophylaxis and outbreak management
    - also possibility of more targeted application of vaccine (area, species etc)
  - Re-consideration of the benefits & costs of MSO out as part of the response to FMD outbreaks (both livestock & wildlife)
  - Consideration of a long-term (longitudinal) FMD surveillance study to establish the role of gazelles of the eastern Steppe

### Suggestions (cont.)

- Strategy/policy
  - Considering the epidemiological situation faced by Mongolia & the OIE requirements for FMD-free zones, consideration should be given to either:
    - devising a simpler & more practical zoning policy or
    - considering alternative approaches, e.g. compartmentalization & commodity-based trade

## RECOMMENDATIONS AND GUIDELINES TO PREVENT PUBLIC DURING LIVESTOCK DISEASE OUTBREAKS

(Dornod Aimag Professional Inspection Agency)

### Public prevention methods during livestock disease outbreaks

During livestock disease outbreaks there should be a health team designated to examine the local human population health. The medical doctors and nurses assigned to work at outbreak sites should examine each individual's alimentary and respiratory systems thoroughly as well as examine lesions on hands and feet. Every individual should have an examination record and number. The Emergency Committee working at the outbreak site will provide and assign personal protective equipment (PPE) and clothing to individuals working with infected livestock. Medical doctors will be responsible in training and controlling the proper use of PPE among individuals. If PPE is not available individuals are required to wear goggles, gloves, 8-10 layers of masks apron and sleeves.

People who have worked with infected livestock should take off all the used PPE and put at a separate spot. These clothes should be disinfected with 4% formaldehyde fume. The individual should wipe hands with 96% alcohol solution, rinse mouth with 10-20% sodium bicarbonate or with iodine or saline solution. Personal hygiene should be kept thoroughly.

Around the entrances a foot bed with disinfectants should be placed. During FMD outbreak it is more effective to warm up the disinfectant solutions before use. Especially, bases and sodium bicarbonate solutions are optimal to warm up to 60-70 C.

Livestock premises should be disinfected using 1-2% solution of sodium salt carbonate ( $\text{Na}_2\text{CO}_3$ ), or 1-4% of formaldehyde solution, or with 2% potassium carbonate solution ( $\text{K}_2\text{CO}_3$ ) twice for 30 minutes with an hour interval. During summer seasons the disinfection needs to be incorporated with insecticides such as 1% chlorophos. This disinfectant should be designated as 1-2 liters of solutions to cover 1 m<sup>2</sup>. Infected livestock premises should be disinfected every morning.

Transportation used for culled or sick livestock transfer needs to be disinfected using 10-20% chlorine solution, 1.5% calcium hypochlorite, sodium etc. The transportation used to transfer dead livestock from FMD will be disinfected by spraying with 1-4% formaldehyde solution of the cabin floors, steps, tires and inside of the truck's load section. Also the tires will go through the disinfection

bed with chemicals. Also for best results a tent for formaldehyde fume disinfection can be set up as well. Dirt on the tires will be cleaned at a specific site. The waste collected at this site will be disinfected with 4% formaldehyde solution and will be buried in a specifically prepared hole/grave and sprayed again with formaldehyde before burial. This burial site is 50 m distance on the way to the disinfection tent. The surface dirt from the tire cleaning site is dug 20-30 cm deep. All the waste from this cleaning site is destroyed by burying in a grave and disinfecting with 4% formaldehyde solution. The cleaning field will be disinfected with 2% sodium hydroxide solution.

All passengers hands will be disinfected with 96% alcohol wipe, shoe soles will be disinfected with 10% chlorine solution. Trains will be disinfected by spraying with 40-42C warm water. After the spray the train will be disinfected with 4% sodium hydroxide solution. Placings are cleaned and all resource water will be pressured out and all doors, windows and sinks will be closed tightly before the disinfection. Disinfection is done with methyl bromide to be allocated 300 mg per 1 m<sup>3</sup>. After the disinfection if the plane temperature is raised up to 15 C, then the methyl bromide will evaporated easily. The disinfection team should wear rubber boots, overall covers, gloves and masks.

## FOOT AND MOUTH DISEASE (FMD) PREVENTION POSSIBILITIES

(Directed to human population)

Livestock such as horses, camels, cattle and pigs as well as humans are prone or susceptible to FMD infection. Especially children are prone to FMD. Therefore, on May 2, 2000 there was a Health Minister's decree #120 to control and prevent human population from this disease. Professionals from the Center of Infectious Diseases with Natural Foci have provided following recommendations for differential identification/diagnosis of the disease in humans and for control and prevention activities.

The source of infection is infected human and livestock (cattle). Humans contract the disease mainly from infected livestock's alimentary products such as milk, milk products and meat (from milking, taking care, culling of infected livestock) through respiratory routes while infected animal is breathing or coughing. The disease causes blister-like eruptions in the mouth, nostrils, and hands and skin rash. The disease usually begins with a fever reaching 40 C, trembling, headache and general toxemic conditions. After a day an onset of painful red sores usually develop in the mouth, on the tip and base of the tongue, oropharyngeal area and in larynx. After some time these small red spots often become 1-3 mm ulcers.

The virus is very resistant in the environment to heat and cold and the virus remains infective in contaminated livestock urine, carcass for 146 days, in the skin, wool for 28 days and in dry sand for 11 days. During July and August in plants and grass for 1 month, in +2-10 C condition for 24-74 days the virus remains infective. In salted meat, meat products 183 days, in raw milk 113 days, in milk boiled at 72 C for 15 seconds, in cheese 21 days the virus remains infective as well.

### Prevention methods

- People working with infected livestock and heard should regularly use personal protective equipment and clothing and should use masks, gloves and aprons at all times.
- People who worked with infected livestock and heard should rinse their mouth with antiseptics such as 1:1,000 Rivanol, 1% manganese solution. If not available use saline and sodium bicarbonate solution instead to rinse mouths regularly.
- Not to use raw milk without boiling or processing
- To strengthen human health examination at outbreaks sites were FMD occurred in livestock.
- People working with infected livestock and heard should regularly keep personal hygiene and not to eat, drink or smoke without washing hands
- If you observe lesions, sore spots, fever etc. you should immediately visit doctor

- People working with livestock should not tend after the livestock with visible sores and lesions, if necessary should clean the lesions with alcohol or iodine and bandage before the work
- People working with infected livestock and heard should use disinfectants
- Livestock and livestock products trade and transportation should be prohibited from infected areas

## RECOMMENDATIONS AND GUIDELINES TO DISINFECT WATER AND WATER RESOURCES

(Dornod Aimag Professional Inspection Agency)

Due to the foot and mouth disease (FMD) serotype O outbreaks in Mongolia (AO10 disease by Mongolian) and the spread of disease through livestock and wildlife through water resources there is a need to disinfect water and water resources following this guideline.

Following recommendations should be followed for disinfection of rivers, lakes, streams and waters:

- To follow nature and environment rules and regulations
  - To prevent from water source contamination
  - Obtain recommendations from other organizations
  - The disinfection team should be aware not to obtain infection themselves and not to transmit the infection
  - The river and lake banks and the waters will be disinfected separately
1. Disinfection of water and water bodies
    - a. For the disinfection of water bodies we will use 200 ml of chlorine per 1 liter of water for the period of 12 hours.
    - b. For the disinfection of water streams we will use 2,000 ml of chlorine fume per 1 liter of water.
  2. Disinfection of the soil around river and lake banks
    - a. Calcium hypochlorite
    - b. Chlorine
    - c. Iodine 1x500 ml

Chemicals mentioned above will be used to disinfect soil 20 m from river banks.

### Disinfection activity control and management:

The disinfection work will be implemented under the professional guidance. Human medical and veterinary professionals will be involved during this disinfection activity. The veterinary inspector of the specialized professional inspection agency will lead the disinfection team. The team leader will do a survey of lakes, rivers and waters following the guidelines. Also team leader is responsible on recording and providing reports to local authorities on sites that are disinfected, distances travelled, amount of chemicals used for disinfection and gas/petroleum used for the team's travels and activities.

The progress of the disinfection activity will be evaluated by the Specialized Professional Agency and the Emergency Committee at the midpoint and at the end

of the activity and some specialized inspection agency staff will evaluate the day to day activity.

The safety of the disinfection team should be considered and provided. The disinfection work should be implemented in short timeframe not to further transmit the disease to livestock, wildlife and birds, as well as to implement the activity in an environmentally safe way.

The information for this guideline was taken from the “Guidelines to control livestock diseases” from the Veterinary and Animal Breeding Agency published in 2010.