

MAJOR DISEASES AND PARASITES COMMON TO WILD AND DOMESTIC ANIMALS IN THE TIBETAN PLATEAU

A Field Guide for Non-Veterinarians

By

Stéphane Ostrowski

Wildlife Conservation Society

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Wildlife Conservation Society, 2300 Southern Blvd, Bronx, NY 10460, USA

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Preface

This field guide has been designed in an intentionally brief format with hopefully easy to understand technical vocabulary, and serves to highlight, rather than detail, the salient aspects of a selection of diseases relevant to both wild and domestic animals in the Tibetan Plateau. It intends to provide wildlife biologists, paraveterinarians, game guards, field staff of Forestry and Agriculture authorities, animal control personnel, and students with a portable reference for diseases common to non-domestic and domestic animals in this region. Those desiring a more in-depth document should seek out relevant literature. It is also designed to accompany the user into the field and should act as a rapid reference source for those encountering sick animals. It provides the reader a brief summary of the cause of the disease, highlights the most characteristic symptoms and informs about the associated level of risk to human beings.

The present document is by no means an exhaustive review of wildlife diseases in the Tibetan Plateau, but instead focuses for a large part on major diseases reported in Tibetan livestock and their guarding dogs, which could pose a risk to wildlife. Evidently I do not imply that all diseases of wildlife find their origin in domestic animals (for example rabies is a good example of a disease circulating in a sylvatic host and of concern to livestock), yet habitat fragmentation, overstocking and global warming are three threats prevailing in the Tibetan plateau, which can separately or in combination potentiate the risk of disease spill-over from livestock to wild ruminants. I have also included diseases with a known sylvatic reservoir, such as rabies or alveolar hydatid disease, which pose a significant risk to domestic animals or humans, yet diseases that pose only a very occasional risk to domestic animals and humans, such as plague, have not been included.

Very little is known about wildlife diseases in this region of the world, mainly because of its size, remoteness and the lack of appropriate expertise. As a matter of fact I have also included a number of diseases not reported in wildlife in the Tibetan Plateau but likely to occur in the future or possibly already present but overlooked. For example foot and mouth disease or peste des petits ruminants, both reported in livestock in Tibet have never been diagnosed, to my knowledge, in Tibetan wildlife, although they have affected Mongolian gazelles and ibexes in Mongolia and Pakistan, respectively, two countries sharing international boundaries with western China.

Hopefully this document will also attract the interest of health professionals in western China and perhaps motivate more in-depth studies on wildlife diseases, a discipline that remains largely unexplored in the country. It is very likely that other diseases common to wild and domestic animals exist in the Tibetan Plateau and wait to be discovered. It is indeed my hope that talented Chinese colleagues, based on a new and original set of information, will produce in the future an updated version of the document.

Wild ungulate communities in the Tibetan Plateau constitute certainly the largest populations of non-domestic large mammals remaining in China, and as such require immediate attention. Although disease is probably not the major threat that jeopardizes their existence, the truth is that we do not know how and to which extent it may influence their demography or pose on the long term a risk of global or focal extinction.

This document would benefit from at least two amendments. Its translation into Mandarin Chinese and Tibetan would be most desirable in order to render it accessible to a larger readership, and adding pictures featuring remarkable symptoms or lesions of each disease, should it only be in livestock, would be most useful.

I wish to thank the Tibet Academy of Agricultural and Animal Sciences (TAAAS) for allowing me to carry out previous mission in Tibet, and particularly Mrs Seiju and Mr Tsering Dorji. I extend my gratitude to all staff at WCS and particularly to Mrs Xie Jan and Mrs Aili Kang.

The structure of this field guide is inspired from a document produced by the US Department of Fish and Game for Alaskan wildlife.

Main wild ungulates of the Tibetan Plateau

The **Tibetan antelope** (*Pantholops hodgsoni*), otherwise known as chiru, inhabits Tibet, Qinghai and Xinjiang provinces in China, and some individuals enter the Ladakh region of India. The total population was estimated to number 75,000 in 1995, down from an estimated 1 million in 1900. The species was historically hunted by Tibetans for subsistence purposes, but more recently poaching for their valuable wool, encroachment by humans and their livestock, interference (e.g. fencing or livestock grazing) with their migrations and movements became the main threats. The protection of this emblematic species in China, under the Wildlife Protection Law which prohibits hunting and trade (without permission) appears to have helped stopping its decline. The species may currently totalize over 100,000 individuals. It was listed in 2000 as Endangered by the International Union for the Conservation of Nature and Natural Resources (IUCN), and on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

The **Tibetan gazelle** (*Procapra picticaudata*), also known as goa, is endemic to the Tibetan Plateau. In China it occurs in Tibet and Qinghai provinces, very few specimens residing or migrating to Ladakh and Sikkim regions of India. The total population size is not known with precision but could be around 100,000 animals. The species is affected, at least locally, by precipitous declines. Overhunting, encroachment by humans and their livestock, interference (e.g. fencing or livestock grazing) with gazelle's movements are considered principal threats. The Tibetan gazelle is listed as Near Threatened by the IUCN.

The **Przewalski's gazelle** (*Procapra przewalskii*) is endemic to Qinghai province in China. Once widespread, its range has declined to six populations near Qinghai Lake totaling perhaps 350-400 individuals. The protection of this species under Chinese Wildlife Protection Law seems to have reduced illegal hunting threat, yet a large proportion of the habitat of this species has already been lost due to human activities. As a consequence livestock encroachment into remaining habitats and increased difficulty of gene flow between subpopulations, due to physical obstacles, may prove fatal to a species confined to a relatively small territory. Grazing competition (and corollary disturbance) and increased risk of disease spill-over from livestock constitute also significant threats. The species is listed as Endangered by the IUCN and on Appendix I of the CITES.

To the exception of a small remnant population in Ladakh, the totality of the population of **wild yak** (*Bos mutus*) is confined to China (Tibet, Qinghai, Gansu, and Xinjiang provinces). Quoted as very abundant in the past, the population has markedly declined to an estimated total of 15,000 animals surviving within relatively small and scattered populations, essentially in Chang Tang and Arjin Shan reserves. Once hunted in large numbers, the Chinese Wildlife Protection law has reduced illegal hunting threat, yet a large proportion of the habitat of this species, which requires extensive tracts of wilderness with little human and livestock encroachment, has been lost. In addition domestic and wild yaks readily hybridize, threatening the species of genetic disappearance, and increasing the risk of interspecific disease transmission. The species is listed as Vulnerable by the IUCN and on Appendix I of the CITES.

The **blue sheep** (*Pseudois nayaur*) is found in China in scattered populations from western Tibet and south-western Xinjiang to the Helan Shan which forms the western border of Ningxia Province (with Inner Mongolia). The species seems to be widespread and relatively abundant within appropriate habitats of the Tibetan Plateau. Competition with livestock is said to be the major threat it faces in China. Interestingly an outbreak of sarcoptic

mange which developed for the past decade among blue sheep in extreme northern Pakistan has markedly reduced abundance locally. This report, combined to informal claims of similar events in western Tibet suggest that the species may be at risk of local decline due to disease. The species is listed as Least Concern by the IUCN.

In China the **argali** (*Ovis ammon*) is found in western and central-north provinces (Gansu, Inner Mongolia, Qinghai, Tibet, Xinjiang, and possibly western Sichuan). Population size and trends in the country are largely unknown. Poaching has been considered for long time to be a substantial threat, yet efforts done by Chinese authorities at prohibiting killing protected species and reducing the available weaponry have reduced this threat during the last decade or so. At the same time however, efforts to sedentarize pastoralists have increased habitat conflicts, grazing competition and risk of disease spill-over to argali. The species is listed as Near Threatened by the IUCN. The subspecies occurring in the Tibetan Plateau, *O. a. hodgsoni* is listed on Appendix I of the CITES.

In China the **Siberian ibex** (*Capra sibirica*) is found primarily in the mountains surrounding Xinjiang province, but also in those of extreme northern Gansu, and Inner Mongolia provinces. Reliable estimates for the species do not exist but it is said to be abundant locally in suitable habitats. In China poaching is a minor threat and competition with livestock seems to be the main problem. The species is listed as Least Concern by the IUCN.

Ninety five percents (c. 60,000) of the world population of **Tibetan wild ass** (*Equus kiang*) occurs in altitude grasslands of western China (Qinghai, Gansu, Tibet and Xinjiang provinces), the remaining survives in northern India. The Chinese population is thought to be stable. The main threat to this species comes from conflicts with humans, since local communities perceive the kiang as an over-user of pastures to the detriment of their livestock. Rampant illegal subsistence hunting, particularly by the staff of mining companies, is also of concern as it is more or less done with tacit consent of local communities. Eventually disease transmission from domestic livestock may also pose a risk given the situation of close cohabitation of kiangs with livestock. The species is listed as Least Concern by the IUCN, and on Appendix II of the CITES.

The **white-lipped deer** (*Cervus albirostris*), is endemic to western China, where it inhabits Qinghai, Gansu, western Sichuan and eastern Tibet provinces. Known to occur in a very large continuous population in the past, it is nowadays scattered in discontinuous subpopulations totalling utmost 50,000-100,000 individuals. The species suffers from hunting and grazing competition with livestock, and is listed as vulnerable by the IUCN.

Reportable diseases

Foot and mouth disease (FMD)

What causes FMD?

- A virus transmitted by respiratory aerosols and direct or indirect contact with infected animals causes foot and mouth disease.

Where does FMD occur?

- Primarily cloven-hoofed domestic and wild animals. Sheep and goats are considered maintenance hosts. Until now wild animals in Asia have not been confirmed maintenance hosts.
- The disease is endemic in many countries in Asia. In China it appears regularly in the form of outbreaks, such as in 2007.
- Foot and mouth disease has so far not been observed in wild ungulates in the Tibetan Plateau.

What are the signs of FMD?

- Foot and mouth disease is characterized by fever and blisters, which progress to erosion in the mouth, nares, muzzle, feet, or teat.
- In cattle and yak excess salivation, lameness and decreased milk production are three common symptoms.
- Infected animals may appear weak, tired, and reluctant to move.
- Sheep and goats show very mild, if any, signs of fever, oral lesions, and lameness.
- Animals usually recover in about two weeks, with very low mortality in adults.

How can I protect myself?

- People very rarely get foot and mouth disease. The infection when it appears is usually self-limited and wanes after a few days.
- Livestock can be vaccinated against the disease.
- **Inform as soon as possible the nearest veterinary authority of any animal suspected of having foot and mouth disease.**

Can I eat the meat?

- Meat from a diseased animal is suitable for human consumption, yet it is important to follow the decision of the veterinary authority concerning the status of the infected animal.

Samples to collect

- As a reportable disease sampling of an animal suspected of foot and mouth disease can only be done by state veterinary staff.

Peste des petits ruminants (PPR)

What causes PPR?

- Peste des petits ruminants is a highly contagious disease caused by a virus.

Where does PPR occur?

- Peste des petits ruminants infects small ruminants, particularly goats.
- Cattle and yak can be infected, but show no clinical signs and do not transmit the virus to other animals.
- In Tibet peste des petits ruminants has been reported in domestic goats in 2007.
- In Asia the disease has been reported in a few species of wild ungulates but never in the Tibetan Plateau.

What are the signs of PPR?

- Most cases of peste des petits ruminants are acute, with a sudden fever which lasts 5-8 days before the animal dies or start recovering. Sudden death with few clinical signs is common in goats.
- A characteristic sign is nasal discharge, followed by necrotic erosions in nostrils and in the mouth.
- Animals can also present severe diarrhea, sometimes tinged with blood.
- Animals may also develop bronchopneumonia with persistent cough.
- Recovering animals are always weak and may be infected by secondary pathogens.

How can I protect myself?

- You cannot get peste des petits ruminants from infected animals.
- Livestock can be vaccinated against PPR.
- **Inform as soon as possible the nearest veterinary authority of any animal suspected of having peste des petits ruminants.**

Can I eat the meat?

- Meat from a diseased animal is suitable for human consumption, yet it is important to follow the decision of the veterinary authority concerning the status of the infected animal.

Samples to collect

- Because it is a reportable disease only state veterinary personnel can sample an animal suspected of peste des petits ruminants.

Highly pathogenic avian influenza (HPAI)

What causes HPAI?

- A contagious influenza virus transmitted between birds by fecal droppings, saliva and nasal secretions causes highly pathogenic avian influenza.

Where does HPAI occur?

- The disease mainly infects birds, most commonly domestic poultry and less frequently wild birds, especially waterfowl and shorebirds.
- In rare instances, this virus can be passed to other animals and people.
- A H5N1 strain of the virus appeared in 2003 in Southeast Asia. In rare cases, people have caught this virus and became very ill or died.
- The disease has been reported in the Tibetan Plateau in poultries and wild birds.

What are the signs of HPAI?

- In peracute form, the bird dies without any symptoms.
- In acute case in poultry, symptoms are highly variable; usually there is an edema of the head, comb and wattle, which also appear dark in coloration. Sinusitis is common, whereas diarrhea is less frequent.
- Occasionally birds will develop neurological signs with torticollis, gait problems, or paralysis.
- When susceptible wild birds are most often found dead without symptoms. On rare occasions neurological signs were observed.

How can I protect myself?

- You can get HPAI if you are in close contact with a sick animal or if feces, saliva or any secretion from an infected animal comes into contact with your eyes, nose, lips, or mouth.

- **HPAI is potentially fatal for humans.**
- **Do not go near a bird that you think has HPAI.**
- Any person exposed to an animal that may have HPAI should **immediately contact the local nursing station or hospital.**
- **Report any mass mortality of wild birds, especially water birds,** to the nearest veterinary authority.

Can I eat the meat?

- Never eat meat from an animal that is suspected to have highly pathogenic avian influenza.
- Do not feed the meat to dogs or cats.

Samples to collect

- Because of the high zoonotic risk and as a reportable disease, only state veterinary personnel can do sampling of an animal suspected of HPAI.

General diseases

Brucellosis

What causes brucellosis?

- Brucellosis is a highly contagious disease caused by bacteria called *Brucella*. Most commonly it is spread in the afterbirth and fluids during calving.

Where does brucellosis occur?

- In the Tibetan Plateau brucellosis infects livestock and particularly yak and cattle.
- Although not yet reported in wildlife in the Tibetan Plateau, *Brucella* may occur naturally in a variety of wildlife species, including wild yak, antelopes, gazelles, and wolves.
- *Brucella* can infect humans.

What are the signs of brucellosis?

- Animals may appear healthy and not show any signs of disease.
- Brucellosis usually affects the reproductive organs and leg joints.
- Often, animals will have swollen leg joints causing limping or lameness (especially in the front legs).
- The testicles may be swollen. Females may abort.
- In people brucellosis often causes a high fever that frequently comes and goes.

How can I protect myself?

- You can get brucellosis through exposure to contaminated parts. The bacteria can enter through cuts or scratches in your skin or through your eyes, nose or mouth. You can also get brucellosis by eating infected meat that has not been fully cooked, dairy products or drinking crude milk from infected animals.
- **Do not cut into diseased parts.**
- **Do not spill fluid from the womb onto the meat.**
- Use extreme care and gloves when handling any fetal membranes or aborted tissues.
- **Wash** your hands, knives and clothes with hot soapy water after handling the animal.

Can I eat the meat?

- Meat from animals with brucellosis should be **thoroughly cooked**.
- Freezing, smoking, drying and pickling **do not** kill *Brucella*.
- Raw bone marrow from infected animals **can** contain the bacteria.
- **Do not feed any parts to dogs.**

- **Report** any animals suspected of having brucellosis to the nearest veterinary authority.

Samples to collect

- Because of the high zoonotic risk, only expert staff is advised to sample an animal suspected of brucellosis.

Rabies

What causes rabies?

- A virus spread in the saliva of infected animals causes rabies.

Where does rabies occur?

- All warm-blooded mammals can be infected.
- In China the most commonly infected animals are carnivores, particularly domestic dogs, foxes, or raccoon dogs. Domestic ungulates are also affected.
- The Tibetan Plateau is not known to be an area where rabies is highly endemic, yet in recent years the number of reported cases has markedly increased in Southwest China, including in Sichuan a province neighboring Tibet.

What are the signs of rabies?

- Rabid animals often lose their fear of humans and may become vicious and attack for no reason.
- They may have a dropped jaw and appear to be "foaming at the mouth."
- Rabid animals may appear weak or paralyzed.
- They also sometimes chew rocks, dog chains, and other non-food items.

How can I protect myself?

- You can get rabies if you are bitten or licked by an infected animal or if saliva from an infected animal comes into contact with your eyes, nose, lips, cuts or scratches.
- If untreated **rabies is fatal for humans** and signs may be undetectable for weeks or months.
- **Do not go near an animal that you think has rabies.**
- Any person exposed to an animal that may have rabies should **immediately contact the local nursing station or hospital.**
- **Report any animals suspected of having rabies** to the nearest veterinary authority.
- If you must kill an animal that you think has rabies, **do not** shoot it in the head.
- Have your dog vaccinated against rabies.

- There are also vaccines against rabies for humans. If you are in a high-risk area or profession (for example veterinarian), contact your health aide or hospital about getting a rabies vaccination.

Can I eat the meat?

- **Never eat meat from an animal that is suspected of rabies.**
- **Do not feed the meat to dogs.**

Samples to collect

- Because of the high zoonotic risk, only expert staff is advised to sample an animal suspected of rabies.

Canine distemper

What causes canine distemper?

- A contagious virus spread in the saliva and secretions of infected animals causes canine distemper.

Where does canine distemper occur?

- The disease is maintained primarily in domestic dog populations worldwide, but its host range is broadening to wild carnivores and expanding geographically.
- In the Tibetan Plateau the disease frequently affects domestic dogs. It is also said to affect wild carnivores, especially wolves.
- Canine distemper is much more common than rabies in the Tibetan Plateau.

What are the signs of canine distemper?

- Domestic dogs with distemper have fever with watery nose and eyes and then pus coming from the eyes or nose.
- They may also sneeze, cough or have diarrhea.
- Eventually they can have neurological problems, shivering like they are cold, stumbling, falling down, having difficulty to get up again, circling or even laying with convulsions.

How can I protect myself?

- The disease is not known to be dangerous to humans.
- Have your dog vaccinated against canine distemper.

- Because it is difficult to distinguish the nervous signs of distemper from those caused by the rabies virus, **any animal showing nervous signs should be considered rabid** and approached accordingly (see paragraph on rabies).

Can I eat the meat?

- Do not feed carnivore meat to dogs and cats.

Samples to collect

- Because of the difficulty to distinguish nervous forms of canine distemper from rabies, sampling of an animal suspected of canine distemper by non-veterinarians is discouraged.

Anthrax

What causes anthrax?

- The disease is caused by a bacterium that can survive for decades in the environment.

Where does anthrax occur?

- The disease affects most mammals and several bird species, but is particularly important in herbivores.
- Outbreaks are often associated with heavy rainfall, flooding, or drought.
- The disease is reported in livestock in the Tibetan Plateau, where it affects in priority sheep, goats, cattle and yak.
- Anthrax may also affect wildlife, particularly wild herbivores.

What are the signs of anthrax?

- In peracute form animals die suddenly without symptoms.
- In acute form the animal presents fever, depression, muscle tremors followed sometimes by blood discharge from nose, mouth and anus, shortly before death.
- Anthrax in wild herbivores varies with the species, but tends to resemble the disease in domestic herbivores.

How can I protect myself?

- You can get anthrax if you are in direct contact with an infected animal or if saliva, blood, or any secretion from an infected animal comes into contact with your skin, eyes, nose, lips, cuts or scratches.
- If untreated the inhalation form (bronchopneumonia followed by septicemia) of the disease is **usually fatal for humans** and signs may be undetectable for weeks.
- **Do not go near an animal that you think has anthrax.**
- **Do not open an animal that you suspect has died of anthrax to avoid contamination of the environment.**
- Any person exposed to an animal that may have anthrax should **immediately contact the local nursing station or hospital.**
- Have your livestock vaccinated against anthrax.
- Remember that anthrax can be present in very old carcasses of dead animals.
- In the Tibetan Plateau anthrax in wild herbivores must always be suspected in the event of mass mortality with little external symptoms, especially in areas where the diseases is known to occur.

Can I eat the meat?

- Raw or little cooked meat (<120°C) is potentially dangerous. Meat from an animal that died from anthrax should therefore **not be consumed**.
- There is a high risk of being contaminated when opening or skinning an animal infected by anthrax.

Samples to collect

- Because of the high zoonotic risk, only expert staff is advised to sample an animal suspected of anthrax.

Abscesses

What causes abscesses?

- An abscess is a pocket of pus in an animal's tissue. It is usually caused when a wound becomes infected.

Where do abscesses occur?

- They may occur in any species of animal and anywhere on or inside body, and in any tissue.

What are the signs of abscesses?

- Animals usually appear healthy and may not show any signs of disease.
- Usually, they are firm lumps of white fibrous tissue filled with thick white or green pus.

How can I protect myself?

- Be careful not to cut into or touch an abscess. If this happens, pus can be spread and contaminate other parts of the carcass. Wash immediately contaminated hands with warm water and soap.

Can I eat the meat?

- Portions of meat containing abscesses **should not be eaten**.
- The rest of the meat is suitable to human consumption.

Samples to collect

- Sample pus on general bacterial transport media, if available, or in a sterile container without transport media.
- Immediately store samples frozen, preferably in liquid nitrogen.
- Ideally refer these samples to a laboratory within two weeks.

Pleuro pneumonia syndrome of small ruminants

What causes pleuro pneumonia syndrome?

- It is a group of contagious diseases caused by bacteria known as *Pasteurella*, *Mannheimia* and *Mycoplasma* and transmitted between animals primarily via aerosols.
- These bacteria can act separately or in combination.

Where does pleuro pneumonia syndrome occur?

- The syndrome affects sheep and goats worldwide, including in the Tibetan Plateau.
- This group of diseases has also been reported in a variety of wild ruminant species including several occurring in the Tibetan Plateau, such as the ibex and the blue sheep.
- In domestic animals the disease affects more severely young animals and often follows a stressful event (poor weather conditions, a sudden change in husbandry, addition of new animals to the herd).
- Because of the good survival of these bacteria in aerosol droplets, the disease can be transmitted over several hundred meters to wild herbivores sharing common pastures with sheep and goats.

What are the signs of pleuro pneumonia syndrome?

- Pleuro pneumonia syndrome can be peracute. Animals die suddenly with few clinical signs.
- In acute cases, animals have fever, followed by watery nose soon turning to purulent discharge. Typically moist cough and difficulty to breath follow, often shortly before the animal dies.
- When opening the thorax, the cavity is filled with straw-colored fluid and the lungs show very red areas with increased or decreased consistency.
- Recovering animals are always weak and may be infected by secondary pathogens.

How can I protect myself?

- Humans are not susceptible to pleuro pneumonia syndrome of small ruminants.
- Protective vaccines are available for domestic ruminants.

Can I eat the meat?

- Thoroughly cooked meat from a diseased animal is suitable for human consumption, yet it is important to follow the decision of the veterinary authority concerning the status of the infected animal.

Samples to collect

- Sample pieces of lungs and fluid in the thorax in sterile containers or on *Pasteurella/Mycoplasma* specific transport media and freeze them immediately after collection preferably in liquid nitrogen.
- Ideally forward the samples to the laboratory within one week.
- To confirm the lesion (but not its cause) sample 1 cm³ of lung and pleura and store in 10% neutral buffered formalin at room temperature. Respect ratio 1:10 for sample volume to formalin volume.
- Fluid in the thorax and blood can also be sampled on a piece of filter paper and stored at room temperature with no humidity.

Exertional myopathy

What causes exertional myopathy?

- Exertional myopathy is a muscle disease that can occur when wild or domestic animals are chased, handled or stressed.

Where does exertional myopathy occur?

- It is most commonly seen in ungulates (hoofed animals), but has been reported in a wide variety of wild animals and birds (for example ducks).

What are the signs of exertional myopathy?

- Animals may appear depressed, weak and stiff. In severe cases they can produce red-brown urine.
- The muscles, heart and kidney are usually affected but signs may be difficult to see.
- There may be differences in the color and textures of muscle groups.
- Early in the disease, affected muscles may look wet and have small bruises. Later, the muscle becomes pale, dry, and very soft. In severe cases, entire muscles may be torn.
- The heart muscle may have pale areas or streaks.
- Lungs are usually dark and wet.
- In bad cases kidneys may be dark brown.

How can I protect myself?

- The disease is not dangerous to humans.

Can I eat the meat?

- Meat from a diseased animal is suitable for human consumption.
- Severely affected animals may be in poor condition, reducing the quality of the meat.

Samples to collect

- Sample 1 cm³ of damaged muscle, kidney and heart in 10% neutral buffered formalin.
- Store samples at room temperature.

Hoof rot

What causes hoof rot?

- The bacteria that can grow without oxygen known as *Spherophorus necrophorum* and *Bacteroides melaninogenicus* cause this disease.
- These bacteria are normal inhabitants of the soil and can also be found in the mouth and intestinal tract of many species of animals.
- Bacteria often enter a susceptible host through a break in the skin between the hooves.

Where does hoof rot occur?

- This disease is contagious and has been described in many species of wild ungulates, particularly gazelles.
- Outbreaks of disease are most common and most severe during periods of extended rainy weather when humidity causes the skin between toes to crack.

What are the signs of hoof rot?

- Abscesses form directly between toes and above the hoof. The hoof may swell 2–3 times its normal size and is extremely painful. The abscess contains thick, foul-smelling pus.
- Infected gazelles often limp and frequently die of starvation.
- Abscesses may also be found in other locations, such as the liver, lungs or mouth.

How can I protect myself?

- People are theoretically susceptible to infection.
- Humans should avoid direct contact with pus-filled abscesses.

Can I eat the meat?

- The meat of animals with hoof rot is safe to eat.
- Discard the infected leg. Cook the remainder of the meat thoroughly.

Samples to collect

- Because you can get the disease, samples should be taken with precautions (gloves, mask, and protective glasses).
- Sample abscesses on general bacterial transport media, if available, or in sterile containers without transport media.
- Immediately store frozen, preferably in liquid nitrogen.
- Ideally refer these samples to a laboratory within a month.

Injuries

What causes injuries?

- Injuries are common in wild animals.
- Animals can often survive even with bad injuries such as broken bones.

- There are four major causes of injuries in wild animals:
vehicle collisions,
gunshot wounds,
fighting with other animals of the same species,
predation.

What are the signs of injuries?

- Gunshot wounds, particularly those from low caliber weapons, may be difficult to see through the animal's hair. They are more visible on the flesh side of the hide.
- Serious injuries caused by fighting between animals of the same species are uncommon. Occasionally, dead animals are found with gore wounds or bite wounds (for example in wolves) on the throat and neck, or horn wounds on the neck, head and thorax (gazelles).
- When related to predation, wounds are usually found on the hind legs, neck and head and sometimes on the flank.
- There is usually a lot of blood and fluids that collects under the skin and extends for some distance in one direction from the wound.
- Teeth marks may not always perforate the hide but there is usually a bruise or bleeding in the skin at the site.

How can I protect myself?

- Injuries are of no danger to humans.

Can I eat the meat?

- Meat from an injured animal is suitable for human consumption, although consumer must be aware of the presence of lead shots in case of gunshot wound.
- Trim off injured and contaminated parts.
- Severely injured animals may be in poor condition, reducing the quality of the meat.

Samples to collect

- In case of suspected gunshot try to collect evidences of projectile damages (perforated bones) or the projectile itself.
- In case of an infected injury, collect pus or necrotic tissue on general bacterial transport media, if available, or in sterile containers without transport media.
- Immediately store frozen, preferably in liquid nitrogen.
- Ideally refer these samples to a laboratory within a month.

Starvation/malnutrition

What causes starvation-malnutrition?

- Starvation occurs when an animal is unable to get the amount of energy or nutrients from food that is required to cover its daily needs.
- There may not be enough food available, or the animal may not be able to reach or get nutrients from food because of environmental factors (deep snow) or physical problems (injury, disease, poor teeth).

When does starvation-malnutrition occur?

- Starvation and malnutrition can affect any wild or domestic species and particularly young, old, weak, or sick animals.
- It usually occurs in winter, often towards the end of this season.

What are the signs of starvation-malnutrition?

- In severe cases animals appear weak and very thin.
- The skin may appear loose with a dull, rough hair coat.
- Wild animals in final stage of starvation have all ribs visible, hips protruding and are often so weak that they are unable to escape efficiently approaching predators and humans.

Can I eat the meat?

- In theory meat from a starved animal is suitable for human consumption, yet of very poor quality.
- It should be remembered also that starvation could result from a disease, and one should always look for signs of such underlying problems, which could ultimately render the meat unsuitable for human consumption.

Samples to collect

- Collect and weigh (± 0.1 g) marrow tissue from long bones, and store in clean containers.
- Keep samples frozen in liquid nitrogen.

Diseases of the head

Nose/sinus bot

What causes nose/sinus bot?

- The larvae of the bot fly cause this condition.
- Lifecycle: The adult female bot fly deposits larvae in the nostrils of the domestic (for example sheep) or wild (argali, ibex) herbivore. Nose/sinus bot larvae attach and grow in a cluster in the nasal cavities, paranasal sinuses or in the throat near the base of the tongue. The larvae are sneezed out in the spring.

Where are nose/sinus bot found?

- Nose bot can be found in domestic and wild sheep throughout the Tibetan Plateau. Other wild herbivores are likely affected.

What are the signs of nose/sinus bots?

- Animals usually appear healthy, yet once the larvae begin to move in nasal passages they provoke nasal discharge, coughs and sneezing.
- When larvae reach paranasal sinuses, animals display very few symptoms.
- When laying their eggs, bot flies harass animals and interfere with feeding.
- Nose/sinus bot larvae are found in the nose, sinuses or airways at the back of the throat.
- The worm-like larvae are clear white and small (1-2 mm) when they begin to develop but grow to 2-4 cm in length over the winter and become yellowish-brown.

How can I protect myself?

- Humans are very uncharacteristic hosts for nose/sinus bot flies or their larvae.

Can I eat the meat?

- Meat from an infected animal is suitable for human consumption.

Samples to collect

- Preserve larvae of bot flies in alcohol (ethanol) 70°. Respect a ratio of at least 1:5 for specimen volume to ethanol volume.
- Keep sample at room temperature.

Coenurosis

What causes coenurosis?

- Several tapeworm species and especially one known as *Taenia multiceps* cause the condition.
- Lifecycle: The adult tapeworm lives in the intestines of canid species (primarily domestic dog but also fox and wolf). The adult tapeworms lay eggs, which are passed to the environment in the feces. Herbivores eat the contaminated vegetation and ingest the eggs, which develop into larvae in the gut cavity. Some larvae migrate to the brain where they bud into a fluid filled cyst called *Coenurus cerebralis*, up to 5-6 cm in size. Carnivores become infected when they eat tissues containing cysts.

Where is coenurosis found?

- Coenurosis is widespread in yak throughout the Tibetan Plateau.
- The disease is known to affect wild herbivores, particularly argali.

What are the signs coenurosis?

- Occasionally animals may appear healthy.
- In the majority of cases because of the increased intracranial pressure animals display neurological symptoms.
- Animals may be unable to walk, display paralysis, head deviation, blindness, or abnormal gait.

How can I protect myself?

- Humans are very rarely infested by larvae of *Taenia hydatigena*. When it happens it is caused by the accidental ingestion of contaminated vegetables and fruits.
- Wash your hands with hot soapy water if contaminated by canid or human feces.

Can I eat the meat?

- Meat from an infected animal may potentially harbor larvae and should therefore be **thoroughly cooked**.
- **Do not feed brain or head of an infected animal to dogs.**

Samples to collect

- It is imperative to collect the whole parasite, including the 'head' of adult worms, for proper identification.
- Larvae cysts can be stored in alcohol (ethanol) 70° or 10% neutral buffered formalin.

- Kill adult worm in glacial acetic acid for 2 min. Preserve them in ethanol 70° or best in AFA solution (100 ml formaldehyde 37-40% + 500 ml ethanol 95° + 50 ml glacial acetic acid + 450 ml water) to avoid them coiling.
- Keep samples at room temperature.

Lumpy jaw

What causes lumpy jaw?

- Bacteria normally found in the mouth of healthy animals cause lumpy jaw.
- The bacteria can enter through wounds in the mouth, which can be caused by coarse feed, when teeth break through the gums during development, and in aging animals with impoverished nutrition.

Where does lumpy jaw occur?

- Lumpy jaw is found in domestic and occasionally wild ungulates such as argali, ibex, blue sheep, and probably also gazelles and antelopes throughout the Tibetan Plateau.
- The disease does not spread between animals.
- It also affects the 'upper jaw' (maxillary bone).

What are the signs of lumpy jaw?

- Infection of the jawbone itself causes firm swellings that can be quite large.
- Swellings contain thick white and yellow pus (abscesses).
- Lumpy jaw may interfere with the animal's ability to eat.
- Other than the swelling on the jaw, animals may appear healthy.
- In wild animals the disease often wanes after several weeks or months.
- Careful examination of jaw and maxillary bone from dead wild animals occasionally reveals bone deformation and osseous proliferation, which are scars of past lumpy jaw disease.

How can I protect myself?

- You cannot get lumpy jaw from infected animals.
- Be careful not to cut into pus-filled swellings if handling a fresh carcass. If this happens, pus can be spread and contaminate other parts of the carcass. Wash contaminated hands with hot soapy water.

Can I eat the meat?

- Meat from an infected animal is suitable for human consumption.
- Do not eat the head.

Samples to collect

- Sample pus on general bacterial transport media, if available, or in sterile containers without transport media.
- Immediately store frozen, preferably in liquid nitrogen.
- Ideally refer samples to a laboratory within a month.

Diseases of the internal organs

Alveolar hydatid disease

What causes alveolar hydatid disease?

- A small (3-6 mm) tapeworm known as *Echinococcus multilocularis* causes alveolar hydatid disease.
- Lifecycle: The adult tapeworm lives in the intestines of canid species (primarily red fox and wolf but possibly also Tibetan fox). The adult tapeworms lay eggs which are passed to the environment in the feces. Rodents (mice, voles) eat the contaminated vegetation and also ingest the eggs, which develop into larvae in their gut cavity. The larvae are enclosed inside of cysts, which form large grape-like clusters in the gut cavity. A fox eats the rodent and also ingests the larvae. The cycle is complete when the larvae mature into adults, which release eggs in the intestine of the fox.
- Dogs can also harbor the adult stage of the tapeworm in their intestine. Humans can develop larval cysts in their liver and less frequently lungs and digestive tract if they ingest eggs shed in fox or dog feces.

Where does alveolar hydatid disease occur?

- This disease has been reported in domestic dogs and humans in the Tibetan Plateau.

What are the signs of alveolar hydatid disease?

- Infested dogs and foxes show no outward signs of disease.
- Infested rodents may appear bloated due to the large larval cysts in their gut cavity.
- If the gut cavity of an infected rodent is opened, the large grape-like clusters will be easily observed.

How can I protect myself?

- Humans are susceptible to this parasite, which can be fatal.
- The larval stage of the parasite found in rodents poses no threat to humans.
- Humans should wear gloves when cleaning up dog feces or handling feces of wild canid species, and wash hands thoroughly afterwards.
- If possible treat preventively domestic dogs regularly.
- Dispose and burn dry dog feces to avoid contact with parasite eggs.

Can I eat the meat?

- People should not eat rodent or fox meat.

Samples to collect

- Because you can get the disease, samples should be taken with great precautions (gloves, mask, and protective glasses).
- Larvae cysts and adult worms can be stored in alcohol (ethanol) 70° or 10% neutral buffered formalin. Droppings from carnivores can be preserved in 10% neutral buffered formalin.
- Kill adult worms in glacial acetic acid for 2 min, preserve them in ethanol 70°.
- Keep samples at room temperature.
- For epidemiological screening feces samples should be kept frozen, preferably in liquid nitrogen.

Cystic hydatid disease

What causes hydatid disease?

- The larvae of the small (3-5 mm) tapeworm *Echinococcus granulosus* cause cystic hydatid disease.
- Lifecycle: The tapeworm needs two hosts: a carnivore (for example wolf or dog) and an herbivore (sheep). The adult tapeworms grow and lay eggs in the intestines of the carnivore. The eggs come out in the carnivore's droppings and contaminate plants, which are eaten by the herbivore. The eggs hatch into larvae that travel to the herbivore's liver, lungs, brain where they form cysts. Carnivores become infected when they eat organs that contain cysts.

Where does hydatid disease occur?

- The adult tapeworm occurs in the intestines of wolves and dogs.
- The larval form or cyst occurs in domestic and wild ruminants, and can also occur in humans.

What are the signs of hydatid disease?

- Carnivores and herbivores usually appear healthy.
- In herbivores, the cysts have thick walls and are filled with a clear watery liquid.
- Cysts are usually found in the lungs and liver but can also occur in the brain or other organs.
- Cysts can be 2 to 30 cm in diameter, but most are 2 to 8 cm.
- The surrounding tissue is usually normal.

How can I protect myself?

- You **can** be infected from tapeworm eggs found in the droppings of carnivores such as wolves or dogs.
- **Wear gloves when handling scats from canid species.**
- The lung cysts in wild herbivores do not infect people.

- Treat domestic dogs regularly; keep dog places as clean as possible. Also, use care when handling dog litters and other substrates that may be contaminated with *Echinococcus* eggs.
- When skinning wolves and foxes, keep in mind that the eggs of this parasite can cling to the fur around their tail and anus.

Can I eat the meat?

- Meat from infected animals is suitable for human consumption.
- **Do not eat any tissues or organs containing cysts.**
- Dogs and wolves can be infected from eating cysts in organs of wild herbivores and spread the disease to people in their droppings.
- **Do not feed infected parts to dogs.**

Samples to collect

- Because you can get the disease, samples should be taken with precautions (gloves, mask, and protective glasses).
- Larvae cysts can be stored in alcohol (ethanol) 70° or 10% neutral buffered formalin. Droppings from carnivores can be preserved in 10% neutral buffered formalin.
- Kill adult worm in glacial acetic acid for 2 min and preserve them in ethanol 70°.
- Keep samples at room temperature.
- For epidemiological screening feces samples should be kept frozen, preferably in liquid nitrogen.

Liver tapeworm cysts

What causes liver tapeworm cysts?

- The larvae of the tapeworm *Taenia hydatigena* cause this condition.
- Lifecycle: The tapeworm needs two hosts: a carnivore (for example wolf or dog) and an herbivore (sheep or antelope). The adult tapeworm grows and lays eggs in the intestines of the carnivore. Eggs come out in the carnivore's droppings and contaminate plants that are eaten by the herbivore. The eggs hatch into larvae that travel to the herbivore's liver where they form cysts. Carnivores become infected when they eat liver containing cysts.

Where do liver tapeworm cysts occur?

- The adult tapeworm occurs in the intestine of carnivores (wolves, lynx, dogs and cats) without causing any harm.
- The larval stage of this tapeworm can occur in a variety of domestic and wild herbivores.

What are the signs of liver tapeworm cysts?

- Carnivores (dogs, wolves) and herbivores (sheep, antelopes) usually appear healthy.
- In the herbivore intermediate host, the larvae form small cysts, which may appear like a small circular “window” on the surface of the liver. There also may be white, star-like scars on the surface of the liver.

How can I protect myself?

- The cysts of *T. hydatigena* that occur in herbivores cannot infect you.
- Cysts can be easily removed during butchering.

Can I eat the meat?

- Meat from infected animals is suitable for human consumption.
- Cooking will kill the parasite.
- Dogs can be infected with tapeworms if they eat the liver cysts.
- **Do not feed infected parts to dogs.**

Samples to collect

- It is imperative to collect the whole parasite, including the ‘head’ of adult worms, for proper identification.
- Larvae cysts can be stored in alcohol (ethanol) 70° or 10% neutral buffered formalin. Droppings from carnivores can be preserved in 10% neutral buffered formalin.
- Kill adult worms in glacial acetic acid for 2 min, preserve them in ethanol 70° or AFA solution (see coenurosis).
- Keep samples at room temperature.

Lungworms

What causes lungworm infections?

- A variety of roundworm parasites are known as “lungworms” (for example *Dictyocaulus viviparus*, *Protostrongylus* spp.).
- Lifecycle: Adult worms are found in the lungs where they lay eggs that hatch into larvae. The larvae are coughed up, swallowed, and passed in the animals’ droppings. In some lungworms, a snail or slug takes up the larvae where they develop into an infective stage. The snails are then eaten by herbivores when feeding on plants. The larvae penetrate the animal’s intestines and travel to the lungs where they

develop into adult worms. Other lungworms do not need a snail or slug host. The larvae develop into the infective stage on plants that are then eaten by the herbivore.

Where do lungworm infections occur?

- Lungworms are found in domestic herbivores.
- In Tibet different lungworms may also occur in wild herbivores.

What are signs of a lungworm infection?

- Animals often appear healthy.
- Animals with severe infections may cough and have difficulty breathing, especially after running. They are generally weak and thin and have a harsh, dull hair coat.
- When butchering, you may find adult worms or small round gray lumps of dead tissue up to 2 cm in diameter in the lungs.
- Lungworms are white, threadlike worms that range in size from 0.1 to 10 cm long.

How can I protect myself?

- You cannot become infected by lungworms.

Can I eat the meat?

- Meat from infected animals is suitable for human consumption.

Samples to collect

- Kill adult lungworms by dropping them for 2 min in glacial acetic acid and then preserve them in Berland's fluid (5 ml formaldehyde 37-40% + 95 ml of glacial acetic acid). Respect a ratio of at least 1:5 for specimen volume to Berland's fluid volume.
- Keep samples at room temperature.

Diseases of the muscle

Trichinosis

What causes trichinosis?

- Trichinosis is caused by a roundworm known as *Trichinella spiralis*.
- Lifecycle: The adult roundworms mate in the intestines of the host animal. The adult females produce larvae that travel in the blood to other parts of the body where they form cysts in the muscle. Some larvae can also be spread in the environment via feces and retain infectivity. Animals become infected when they eat meat with cysts or larvae in the environment.

Where does trichinosis occur?

- Trichinosis can virtually infect any mammal species.
- In wildlife it occurs principally in carnivores, such as bears, wolves, foxes, lynx, but also wild boars and ground squirrels.
- Pigs and to a lesser extent horses are important hosts for *Trichinella* worm.
- Humans and dogs can also get trichinosis by eating infested meat.

What are the signs of trichinosis?

- Most often animals appear healthy.
- Trichinosis is hard to detect when butchering because there are few signs.
- Larvae (0.1 cm coiled) form cysts usually in the muscles of the jaw, tongue, and diaphragm.
- Cysts are 0.1-0.2 cm in diameter and may therefore not be visible to the naked eye.
- Animals may have swollen intestines with small bruises.
- Affected muscles and associated lymph nodes (glands) can be soft and swollen.

How can I protect myself?

- You **can** get trichinosis by eating meat from infected animals that has not been thoroughly cooked.
- All bear and lynx meat should be considered possibly infected.
- Cook thoroughly meat particularly from pig and horse.

Can I eat the meat?

- People can get trichinosis by eating infected meat that has not been adequately cooked.
- **Meat should be well cooked** (internal temperature of meat should be at least 60°C).
- Freezing, smoking, drying, salting and microwaving **may not** kill the larvae.
- **Do not feed infected parts to dogs.**

Samples to collect

- Because you can get the disease, samples should be taken with precautions (gloves, mask, and protective glasses).
- 50 g of tongue, jaw or diaphragm muscles must be sampled, stored refrigerated at +4°C if the laboratory investigation is possible within one week or in liquid nitrogen for a longer delay.
- For indirect testing collect blood, extract serum or plasma within 12 hours and store in liquid nitrogen.
- Alternatively dry blood or meat juice on a piece of filter paper and store it without humidity at room temperature.

Diseases of the skin

Contagious ecthyma

What causes ecthyma?

- A virus spread by direct contact with scabs on infected animals causes contagious ecthyma.

Where does ecthyma occur?

- Ecthyma occurs in domestic small ruminants throughout the Tibetan Plateau and possibly also in wild ruminants.
- It is most common and severe in younger animals.
- Humans can also be infected.

What are the signs of ecthyma?

- Papules form into vesicles and thick scabs on the head, mainly on the lips, gum, nose, eyelids, and ears.
- Scabs on the mouth may make it difficult or painful for animals to eat.
- Scabs can also occur on the udder and the top of the foot just above the hoof or between toes.
- If scabs are on the feet, animals may be lame.
- Animals that are heavily infected may be weak.

How can I protect myself?

- You can get ecthyma by touching scabs on an infected animal or by touching anything that has come in contact with the scabs. The virus enters through cuts or scratches in your skin or through your eyes, nose or mouth.
- **Wear gloves.**
- **Do not cut into blisters or scabs.**
- Wash your hands, knives, and clothes with hot soapy water after you finish butchering.

Can I eat the meat?

- Meat from an infected animal is suitable for human consumption.
- Trim off affected parts.
- Severely infected animals may be in poor condition, reducing the quality of the meat.
- **Do not feed infected parts to dog.**

Samples to collect

- Because you can get the disease, samples should be taken with precautions (gloves, mask, and protective glasses).
- Content of blisters and scabs on virus transport media, if available, or in sterile containers without transport media. Immediately store frozen, preferably in liquid nitrogen. Ideally refer these samples to a laboratory within two weeks.
- For indirect testing blood can be collected, serum or plasma extracted within 12 hours and stored in liquid nitrogen.
- Alternatively blood can be dried on a piece of filter paper and stored without humidity at ambient temperature.

Sarcoptic mange (Scabies)

What causes sarcoptic mange?

- A highly contagious microscopic skin-burrowing mite, known as *Sarcoptes scabiei*, causes sarcoptic mange.

Where does sarcoptic mange occur?

- Sarcoptic mange infects the skin of domestic and wild animals, such as blue sheep and ibex, in the Tibetan Plateau.
- The disease affects ruminants but also carnivore species.

What are the signs of sarcoptic mange?

- Animals infected for long time are usually in poor body condition.
- Sarcoptic mange is often found on the head and ears, but can occur on other parts of the body in domestic ruminants (for example sheep). Clinical symptoms include persistent and intensive itching, loss of hairs and thickening of the skin, which appears grayish with visible desquamation.
- Intensive itching may also lead to skin bleeding and purulent bacterial secondary infections.
- In blue sheep sarcoptic mange lesions predominate on forelegs and brisket.

How can I protect myself?

- You can get mange from infected animals, yet the infection derived from animals is usually self-limited and wanes after a few weeks.
- You should avoid manipulating without gloves an infected animal.

Can I eat the meat?

- Meat from infected animals is suitable for human consumption. However human exposure may occur while skinning a mangy animal.

Samples to collect

- Scrapes of skin lesions in alcohol (ethanol) 70°.
- From a dead animal collect 0.5 cm-thick pieces of abnormal skin in 10% neutral buffered formalin. Respect ratio 1:10 for sample volume to formalin volume.
- Keep sample at room temperature.

Warbles

What causes warbles?

- Warbles are parasitic larvae of the warble fly.
- Lifecycle: The adult fly lays eggs on the hairs of the ruminant's legs and lower body. The eggs hatch into larvae, which penetrate the skin, and travel under the skin to the animal's back. The warbles grow there until late spring, when they break through the skin and drop to the ground, where they transform into adults.

Where are warbles found?

- Warbles are found in domestic stock in the Tibetan Plateau particularly in cattle and yak, but also in wild herbivore species such as in the argali and possible in the Tibetan antelope.
- It is still unclear whether warble flies infesting domestic and wild animals belong to the same species.

What are the signs of warbles?

- Animals usually appear healthy, although those with heavy infestations may be weak.
- While laying their eggs, warble flies harass animals and interfere with feeding.
- Warble fly larvae are found under the skin on the ruminant's back, where it is often associated with a painful swelling.
- Larvae are yellowish-white, about 3 cm long.

How can I protect myself?

- Warble flies or their larvae cannot infest you.

Can I eat the meat?

- Meat from infested animals is suitable for human consumption.
- Warbles in infested animals reduce the quality of both hide and carcass.

Samples to collect

- Larvae of the warble fly should be preserved in alcohol (ethanol) 70°. Respect a ratio of at least 1:5 for specimen volume to ethanol volume.
- Keep sample at room temperature.