

# Sanitation-Diseases and Parasites of Foxes

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**T**HE raising of foxes under controlled conditions is a permanent agricultural development. Profits compare favorably with those derived from other similar enterprises and can be obtained if the same business-like methods are applied. The newness and rapidity of development of this industry have left many points of specific information wanting. Foxes in captivity present, not only the usual problems of animal care and management as do domestic live stock, but coupled with these are difficulties met with in maintaining wild animals in captivity. Hygiene in fox farming involves the establishment of conditions most conducive to good health with attention centered, not so much on curing disease, as on removing some of its causes.

## Prevention

The prevention of disease on fox farms is of importance, not only because many ailments of foxes are preventable, but because curative treatment is less successful with foxes than with most domestic animals. One of the factors that makes attempts to cure foxes unsatisfactory is that frequently the sick animals show no apparent symptoms of disease until after the condition becomes grave or serious. The inclination in foxes to hide symptoms often prevents an early and accurate diagnosis, without which much intelligent treatment is impossible. Consequently it is important that fox ranchers keep always in mind that it is better to try to prevent diseases than to attempt to cure them.

Foxes can be raised on any type of soil that is well drained and capable of producing some shade. The land on which the pens are erected should be

well drained, as poorly drained land favors the development of bacteria and parasites, and such diseases are commonly spread by surface water draining from one pen to the other. This can be prevented by digging drainage ditches around each pen and by placing enough soil in each pen to make its surface higher than the surrounding ground. Crowning such a surface also tends to make it self-cleansing when washed by rains or melting snow.

## Pens

To lessen chances of spread of disease, pens should be at least 10 feet apart and units of 25 to 50 pens in the same guard fence are much safer than larger units of 50 to 100, as small units of foxes have a better chance to combat disease outbreaks when they occur. Large pens are advisable, as small pens prevent the animals from taking proper exercise and also tend to invite contamination of the soil. Refuse and droppings should be cleaned from pens frequently as they tend to harbor bacteria and parasite eggs. If pens are not to become a troublesome source of parasitic and infectious diseases, they should be so constructed that the soil can be readily removed and new soil put in its place. It is a good practice to change the soil in breeding pens at least once a year. If pens are of the smaller, knock-down type, they may be moved to clean ground. If of permanent construction on wood or concrete floors, they should be washed frequently with water from a hose. The ideal pen construction is to have animals on wire pens elevated high enough above the ground to facilitate easy and thorough cleaning of the areas under the pens.

### **Feeding**

Many outbreaks of disease on fox farms have resulted from careless feeding methods and the use of spoiled feeds. Food poisoning has been responsible for losses among old as well as young fur animals. The prevention of this is to use wholesome foods and to employ sanitary methods in preparing and dispensing of food. Some of the troubles that may be attributed to dietary errors are rickets, convulsions, sore eyes, abortion, abandoning of young, killing of young, failure of young to make proper growth and development, insufficiency of milk supply, failure to reproduce, and imperfect development of fur. Proper feeding is very essential to prevent nutritional diseases. In the selection of food for foxes it should be remembered that they are carnivorous animals. In the wild they subsist largely on small animals, birds, fish, insects, and a limited quantity of vegetable matter. Just what modification of their diet in the wild will ultimately be found best for them is not yet definitely known. A wide variance of materials used and proportions in which they are used is found on many successful fox farms.

### **Meat**

The general opinion, however, is that meat should constitute 50 to 60 per cent of the diet and the remainder should be made up of cereals with some vegetables added. The ration should be palatable and a form easily digested. Sudden changes in feed or proportions of ingredients should be avoided. Nearly all animal tissues may be used but fat is not relished and harm may result from excessive amounts. If rabbits and other small animals are used, care should be exercised to prevent tape worm infestation of which these animals are intermediate hosts. Fish and other marine animals are responsible for infestation of foxes with pathogenic flukes. More food, especially meat, should be given prior to and during the breeding season, and ample food with minerals should be

given to females during gestation and lactation periods.

Feeding and drinking dishes should be clean, and water supplied should be fresh, pure and cool. After each meal, feeding utensils should be washed and sterilized in boiling water. Feeding should be a painstaking task in which the requirements of each individual animal are considered. They should be fed more sparingly in hot weather than in cold. They should be given fresh cool water daily during moderate weather and more frequently in hot weather.

Contagious diseases are caused by specific germs which produce disease when they gain access to susceptible hosts. They are inclined to spread and are usually difficult to cure and often result in a high mortality. When diseases do not cause death, they frequently leave the animals permanently impaired.

### **Quarantine Pens**

Every fox farm should be equipped with a group of quarantine or retention pens which should be at least fifteen feet apart and several hundred feet from the main ranch and the feed room. There should be a sufficient number of such pens to accommodate ten per cent of the foxes on the ranch. New foxes, or foxes for boarding purposes, should be quarantined for infection of any kind and, if necessary, treated before being placed with healthy animals or in breeding pens. Sick animals should be isolated at once as a precautionary measure. Foxes returning from shows or other ranches should be kept in quarantine at least three weeks. If they have been exposed to any disease, it will become apparent in that time.

It is well for a rancher to maintain strict quarantine against any disease outbreaks in a neighborhood. Dogs, cats, and various other animals as well as the human being may carry infection from ranch to ranch. Visits should be discouraged and trespassing prevented insofar as possible. Quarantined foxes should be kept under close observation for symptoms and should be thoroughly ex-

amined, preferably by a competent veterinarian, before they are released from quarantine and placed on the main part of the ranch. Animals that become sick while under quarantine should be promptly sent to an isolation hospital and placed under treatment of a competent veterinarian. To other foxes that have been exposed to such animals, the quarantine should be made more rigid and extended another three weeks. Pens in which these animals become sick should be very thoroughly cleaned and disinfected and then left vacant as long as practicable. It is advisable to have special attendants to care for sick or quarantined foxes. These persons should keep away from healthy animals and feed-houses, and in every way try to prevent the spread of the disease. Attendants caring for well animals should never go near pens containing sick or quarantined animals. When this method is not possible or practical, the caretaker should feed and care for the healthy animals first, then the suspects, and last, those visibly sick. Separate overshoes should be used and carefully cleaned and disinfected each time after using them.

#### **Utensils**

A special set of feed pans, tongs, and other equipment should be used in the infected pens. None of this equipment should be moved from one place to the other without being disinfected. Whenever there is any doubt as to the cause of the death of a fox, it is a good policy to assume it died of an infectious disease and precaution should be then taken to limit the spread of this disease.

Sick or dead foxes should never be taken to the feed room. Dead foxes that have died from a disease should be pelted in some out of the way place and the carcass burned. A good disinfecting agent to use for disinfecting houses, nest boxes, feed houses, tongs, instruments, and other utensils, is three per cent cresol solution.

#### **Treatment**

The first prerequisite in successful

treatment or control of any disease is that a definite and accurate diagnosis be made by someone competent to make such a diagnosis. The program outlined should be carefully carried out and in no instance should one jump from one pet theory to another daily.

A growing need for a satisfactory method for maintaining the health of foxes has been brought about by the rapid increase in the number of this animal kept in captivity on farms for commercial production of fur. In every community one finds one or more poorly informed individuals ever willing to furnish treatments for "curing" every malady to which these are subject. The damage that is done by these treatments is closely seconded by the patent nostrums sold under misleading advertisements claiming phenomenal results.

These conditions are in no particular sense different from those encountered among the breeders of domestic live stock, but many veterinarians are not familiar with food habits, anatomy and general food habits of those animals kept for furs. They, in many cases, have avoided giving their professional attention and in this way have more or less encouraged the excuse for unscientific treatments.

#### **Fox Distemper**

Fox ranchers, as well as some veterinarians, usually refer to every disease in foxes in which no apparent cause is known as "distemper". Many of these diagnoses are wrong. There are several acute, infectious diseases of foxes, none of which present the same symptoms as distemper in dogs. This term previously came into use because of the occurrence of a disease in foxes somewhat similar to canine distemper. There appeared forms of disease in foxes that could be ascribed as upper respiratory forms, nervous and intestinal forms. However, it was early believed that foxes must be susceptible to other diseases and work was started on various forms of outbreaks on fox ranches.

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tion of the one-toed structure (e) as found in modern horses, although the terminal phalange retains a cleft in its anterior border, as was common in previous genera.

#### **Prejvalski horse**

Several species of horse-like animals are yet alive in their wild condition in Asia and Africa, all of those of Europe and the Americas being either domesticated or of domestic ancestry. Of the true wild horses but one remains: the Mongolian or Prejvalski horse, which inhabits the Gobi desert of central Asia and the neighboring regions. "It is a small animal standing but 12 hands, of a yellow dun or 'buckskin' color, with black mane, tail, and legs and a white muzzle. There is no forelock, the mane is short and upright and there is a decided beard beneath a relatively large head." (2)

Many other genera and species of extinct equidae have been discovered and described by various authors, and several extinct examples of the genus *Equus* have been found in North America. However, the modern horse, as we know it, is descended from European and Asian forms.

#### **Bibliography**

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- (2) Lull, R. S., *Organic Evolution*, 1929.
- (3) Lydekker, R., *The Horse and Its Relatives*, 1929.

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##### **Paratyphoid Infection**

This is a disease which was very prevalent in Iowa in 1925 and again in 1938. It is an infection especially of young animals. The course of the disease varies greatly, the sick animal living from one week to eighteen days. The mortality rate is extremely high in some cases, reaching sixty per cent of all puppies born during the year. The disease usually occurs as an epidemic.

**Symptoms:** The symptoms are marked weakness, loss of weight, rough coat, diarrhea, and occasionally convulsions. In outbreaks that occur during the winter a pus-like discharge is noticed from the eyes and nostrils. In summer outbreaks this symptom has never been noticed.

**Post Mortem Lesions:** The eyes are markedly sunken, the spleen is much enlarged and usually a very dark color. The intestines are greatly inflamed. In cases showing a nasal or eye discharge the upper respiratory tract is inflamed and frequently pneumonia is present. In those cases that fail to show an eye or nasal discharge, the lungs and respiratory tract appear to be normal.

The paratyphoid organism can be isolated from the spleen of fatal cases and when injected into healthy foxes will produce the disease with the same symptoms as found in ranch cases. The organism can be passed serially from fox to fox—usually killing them in eighteen days.

Vaccination with a product prepared from the specific organisms causing the disease appears to be effective in controlling the disease in some cases. This, along with proper sanitation, hygiene and isolation of infected cases, tends to control the infection.

##### **Fox Encephalitis**

This disease became very prevalent in 1926-1927 and was known to have been introduced on a number of farms in several states by foxes that had been exhibited at fox shows. Fox encephalitis is due to a filtrable virus which especially effects the nervous system. The disease appears to attack young and old animals in about the same proportion, the mortality rate ranging from fifteen to forty per cent. Death usually occurs early in the disease and for this reason the dead fox is usually in good flesh.

**Symptoms:** Most animals dying during an outbreak will be found dead, and usually it is reported that the fox was seen some hours before and appeared perfectly healthy. When symptoms are observed on ranches there are usually

nervous manifestations. A series of convulsions is the most common symptom—a sleeping stage quite often occurs. A sudden, extreme weakness is seen and paralysis of one muscle or of a group of muscles is present. There is no discharge from the eyes or nostrils, and the animal usually dies in the state of coma.

Lesions: The post mortem lesions in this disease are frequently very baffling as, in many cases, only microscopic lesions are present, and the various organs appear to be normal to the eye. In most cases there are hemorrhages of varying degree present on the internal organs. These hemorrhages more frequently appear on the heart, thymus gland, adrenal gland, pancreas, lymph glands, lungs, in the digestive tract, in the stomach, intestines, and many times in the lining of the lung cavity and abdominal cavity; occasionally hemorrhages are found in the brain, spinal cord, and many nerves. Microscopic examination of the brain and spinal cord show changes occur in the central nervous system such as hemorrhage and round cell infiltration.

The disease may be transmitted from sick to healthy animals by injection of brain material from infected animals into the brain of healthy animals or into the nasal passages of healthy animals. Animal inoculation made intraperitoneally, subcutaneously or intramuscularly usually fail to produce the disease even though an infective agent be present. The infected animals usually show symptoms in from four to seven days and death usually occurs in twelve hours after symptoms are first noticed. The lesions in experimentally infected animals are identical with those of natural infected animals.

Attempts have been made at producing an artificial immunity from this disease with a fair degree of success under favorable conditions. However, nothing can be advised by way of control measures at present other than rigid methods of hygiene and quarantine, and use of biologic products as may be recommended by a veterinarian.

### **Parasites of Foxes**

In the control of parasites of the fox the major problem is that of minimizing reinfestation. Anthelmintics must be used regularly on most ranches but they need not be used frequently if the time of administration is wisely chosen and proper sanitary and preventive measures are practiced throughout the year.

There are certain periods in the year when outbreaks of the different parasitic diseases occur. Foxes should not be promiscuously dosed for worms but the rancher may very advantageously treat these diseases at the beginning of their seasonal occurrence. All those infested should be promptly and properly treated and sanitary measures instigated to prevent reinfestation. We know that some ranchers have been able to operate over a long period of time without use of anthelmintics by breaking into the life cycle of the parasites by use of proper sanitation. The most practical way to do this with common internal parasites is to prevent contact of foxes with their feces, check drainage from one pen to the other, and by care that persons do not track feces from one ranch to another or one pen to another. Another method is to place the animals on wire which is more expensive and in many cases impracticable. The pens should be cleaned of feces at each thaw during the winter and completely cleaned in the spring as well as daily during the summer months. Sanitation in watering and feeding should be practiced.

### **External Parasites**

The common external parasites of the fox are fleas and ear mites. Lice and mange are of only occasional occurrence. Fleas are present in varying degrees on almost all fox farms, especially during moist and warm weather. They are most prevalent on those ranches where the foxes are kept in small enclosures and where sanitation of the houses is neglected. The species found is the same as found in the dog (*Ctenocephalus canis*). The infested animals may or may not

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scratch themselves. Infestation is best determined by a careful examination of the animal in the head region, neck, back, and abdominal line for the parasites themselves as well as the small pin point spots on the skin. A mixture of one part freshly ground derris root and two parts flour, talc or some other powder as a carrier, applied as a dust, is a good remedy. Pyrethrum powder, if fresh, also constitutes a satisfactory flea powder when it is rubbed or dusted into the fur. In heavy infestations treatment should be repeated in ten days. The destruction of immature fleas is just as important as destruction of the adult parasites.

Since immature forms tend to collect in the houses, treatment of the foxes should be accomplished by a thorough cleansing and disinfecting of the houses, nest boxes and chutes. All litter and debris should be removed and burned and the houses sprayed with three percent cresol solution.

*Lice:* Although blue foxes from the islands off Alaska are commonly infected with the blood sucking louse (*Linognathus piliferus*), lice are rarely found on red, cross, or silver foxes. When lice are present they have a tendency to collect in the region of the eyes, particularly the upper lids. A good treatment is the application of two percent cresol to the infested parts. Treatment should be repeated in sixteen days. In heavy infestations dipping in a two percent solution of cresol followed by dipping in warm soap suds is advisable. Care must be exercised that no fluid gets into the nostrils and that the weather is warm.

*Ear Mange (Otodectes cynotus):* The parasite responsible for this condition is present on many fox farms. Because of the marked tendency for the parasite to spread, the majority of foxes on affected ranches are usually infested. Mildly infested animals show no apparent symptoms except occasional shaking of the head or pawing and scratching at the ears. In more serious cases symptoms are: drooping of one or both ears, dis-

charge from the ears, spells of turning in a circle, and convulsions. In early stages of infestation the deeper portions of the ear canal, especially the grooves, show a frost-like appearance which is due to collection of large numbers of parasites. Soon a scaly-like material appears. In time a dark material appears. A good remedy for ear mange is a mixture of one part iodoform, ten parts ether and twenty-five parts cottonseed oil. This is applied to the ear surface with small cotton pledgets. Two treatments at intervals of ten days should be given. The only practical method of controlling ear mange is to eradicate it by treating all foxes on the farm at the same time and by properly cleaning and disinfecting the houses.

*Mange:* Although foxes in the wild suffer from mange outbreaks, very little trouble is experienced on fox ranches. It is a very serious problem once it gains entrance to a ranch. Most commonly the mange is due to *Sarcoptic mange* mites. In the fox, mange is usually not recognized until it has become quite extensive. This is due to the long fur of this animal. The first noticeable symptom is an unusual amount of scratching or a tendency to gnaw at certain parts.

### Internal Parasites

The common internal parasites of ranch foxes are round worms (*Toxascaris leonina*)-(*Toxocara canis*), hook worms (*Uncinaria stenocephala*), lung worms (*Eucoleus aerophilus*, *Crenosoma decortatum*), thread worms of the bladder (*Capillaria plica*), tape worms, flukes (*Alaria americana*, *Nanophyetus salmincola*), and coccidia (*Isospora bigemina*, *Isospora canivieolis*).

Inasmuch as practically all the common internal parasites of foxes are reproduced by eggs, larvae, or cysts that are voided in certain excretions, usually the feces, the daily cleaning and disposal of feces is advisable. Fish, wild rabbits, and other kinds of small animals used as meat are likely to be infested with immature stages of flukes and tape worms infective for foxes; the meat should be subjected to cooking or prolonged freezing.

*Round Worms:* Practically all fox pups become infested with round worms. These parasites are common in pups two weeks to five months of age but are extremely troublesome in those two or four weeks of age. Heavy or troublesome infestations are not so common in adult foxes. Heavily infested pups are unthrifty, their fur is lusterless and feels dry and harsh. Slow growth, potbelly, emaciation, anemia, restlessness, and digestive disorders are common. Death from obstruction of the intestinal tract by masses of worms frequently occurs in young puppies. It seems advisable to make a general practice to dose all pups when they are between seventeen and twenty-five days old. Oil of chenopodium at a dose rate of .05 to .1 cc. per kilogram of body weight and combined with at least ten times its volume of castor oil; or oil of chenopodium one part to twenty-one parts castor oil, giving 1 cc. for each pound of body weight. Tetrachlorethylene is at present the generally accepted anthelmintic and is sold under many various trade names. The pups are taken away from the vixen before the morning feed, treated about eleven o'clock, and returned at one o'clock. It is advisable to treat pups on warm days as there is a decided danger of the vixen carrying her pups out of the den when returned to her. The proper sanitary measures should always be followed on the pens and houses after treatment.

*Hook Worms:* These are common parasites of adults as well as pups over ten weeks of age. Careful watching of foxes is necessary during July and August, as pups from three to six months are most susceptible. Although the seasonal occurrence of this disease is during the summer and fall, it may occur in winter. After pups are ten weeks of age it is advisable to have microscopic fecal examinations made of all foxes showing any indication of hook worms. The symptoms of hook worms are poor growth, anemia, unthriftiness, emaciation, diarrhea, and passage of large quantities of bloody mucus in the feces.

Tetrachlorethylene is a satisfactory

treatment for hook worms. It is given on an empty stomach, .02 cc. per kilogram of body weight. Since in many cases trouble is experienced with inhalation suffocation, care should be exercised that no capsules are broken in the mouth. Patients should be watched a few minutes after being dosed. Artificial respiration should be performed immediately on those showing signs of collapse. It is advisable to exercise certain dietary precautions in connection with the use of tetrachlorethylene. One is to restrict fats from the first meal before dosing. Feeding patients a high calcium diet for a few days before and after treatment appears advisable.

*Lung Worms:* Due to the extensive losses they cause, lung worms unquestionably are the most troublesome and important of internal parasites. They are usually more troublesome on shady ranches or on those poorly drained. Old ranches are usually worse than new ones. The predominating symptoms are wheezing, rattling, spells of deep coughing, unthriftiness, anemia, emaciation, and nasal or eye discharge. It is a chronic and prolonged disease; usually symptoms are apparent for weeks before the patient recovers or becomes seriously sick. Except for a few days before death in serious cases, there is usually no loss of activity or appetite. The chronic and prolonged course of the disease distinguishes it from infectious respiratory diseases. In case of infectious diseases, death occurs much earlier.

The most successful method of controlling lung worm trouble is to prevent it. On new ranches and those not affected, precaution should be exercised to prevent it getting started. Foxes showing any signs of lung worm infestation should be immediately quarantined. It takes only a short time for heavily infected foxes to contaminate a breeding pen.

Good success in treatment of cases of lung worm disease has been encountered by combination of two treatments—namely, confinement in isolation pens with raised mesh wire floors and by periodic use of tracheal brushes at one to

three week intervals. Recovery in heavy infestations takes from two to four months. In most cases the only treatment necessary is to confine foxes to pens with wire bottoms. The type of wire used is one inch hexagonal mesh, No. 16 steel wire galvanized after weaving. The inside dimensions of the pen are 16 x 6 x 6 feet, with houses and nest boxes provided.

There is no drug that has proven of any great value in this condition.

*Bladder Worms:* This is a fine, thread-like worm which weaves itself into the urinary bladder and occasionally the pelvis of the kidney. It produces a cystitis but is not generally considered a serious menace. There is no curative treatment. Prevention appears to consist mainly of pen sanitation.

*Tape Worms:* This parasite is not very common in ranch foxes but is frequently encountered on a few ranches where fish and rabbits are fed raw. Since no work has been done in treatment for this parasite, any recommended treatment should be attempted only with greatest caution.

*Flukes:* This disease appears to be more or less confined to the Pacific northwest where it is referred to as salmon poisoning. There is no treatment for this disease once symptoms develop. The preventive measures are feeding of fish only after cooking or subjecting it to prolonged freezing.

*Coccidia:* This parasite seems to be very common in all foxes. It may cause severe digestive disturbances such as severe diarrhea with passing of blood in the feces. The symptoms are bloody diarrhea, unthriftiness, roughening of the fur, anemia, weakness, and emaciation. Very few deaths occur from this disease in foxes. It may be controlled by proper pen sanitation, but there is no known medicinal treatment to rid foxes of this disease.

In addition to the mentioned diseases and parasites, foxes are very susceptible to infections with the common pus-producing organisms, and many times abscesses may develop from such infections following wounds or unclean vaccination

needles. Foxes are also susceptible to many of the non-specific diseases such as enteritis, gastritis, and several others common to other species of animals. Many other conditions may occur such as mineral poisoning, fractures, and other injuries which are dealt with in the same manner as similar conditions in other animals.

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## OCCUPATIONAL DISEASES—

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entire extremity. At the same time there is edema and swelling of the regional lymph glands."

Most lesions appear on the forearm and wrist. The organisms often go through unbroken skin, and may withstand disinfection with Lugol's solution and sublimate and also thorough washing. The disease is treated with antiseptic compresses and ointments. Anti-anthrax serum intramuscularly and neosalvarsan intravenously are recommended.

*Undulant Fever:* This disease is not as important in veterinarians as might be imagined. Younger veterinarians seem to be affected with it for a while, but older veterinarians appear to acquire an immunity to the disease. Thomsen urges veterinary students to undergo vaccination with abortus vaccine before they go into practice.

*Equine Stomatitis:* The disease is manifested by small blebs in the mouth, and partly by pustular dermatitis of the hands and face. Infected persons may transmit the infection to horses.

*Cowpox:* This condition has been reported, but is of small consequence as an occupational disease of veterinarians.

*Foot and Mouth Disease:* This condition takes an acute benign course. It is characterized by fever, blebs in the mouth, lips, between the fingers and around the nails and on the hands and toes. It is of importance mainly in that it can be transmitted to cattle.

*Other Infections:* Conjunctivitis, panaritium, abscesses from strangles abscesses, chicken pox and malignant edema

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