Disease and mortality in captive wild dogs (Lycaon pictus)

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ABSTRACT
A retrospective survey on the causes of disease and death in captive wild dogs (Lycaon pictus) (n = 87) presented for examination and investigation from 1983 to 1995, revealed that 50 were less than a week old, 13 were between a week and 1 year of age, 7 were less than 5 years old, and 6 were older than 5 years. The age of 11 adult dogs could not be determined. The cause of death could not be determined in the majority of neonates but 37 probably died of exposure and 13 of septicaemia and pulmonary lesions. Various causes of trauma, including aggression and siblicide, were diagnosed in 13 wild dogs. Lesions of the lungs, kidneys, heart, pancreas, uterus, intestines and skin were diagnosed respectively in 4, 6, 3, 5, 5 and 2 of the cases. An aberrant behavioural pattern was diagnosed in a hand-reared wild dog.

Key words: disease, Lycaon pictus, mortality, wild dog.

INTRODUCTION
Wild dogs (Lycaon pictus), one of the most threatened carnivores in Africa, are kept in captivity in zoological gardens and breeding stations in many places worldwide. Although relatively little appears to have been published on the causes of disease and mortality in captive wild dogs, trauma, metabolic disturbances, bacterial infections, parasitic infections, protozoal infection, neoplasia and vaccine-induced disease have been described. The decline in numbers of free-living wild dogs has been ascribed, at least partly, to disease, and mortality in captive populations may give some indication of the extent and range of conditions that may affect wild dogs. This paper presents a list of conditions diagnosed in captive wild dogs presented either for clinical or post mortem investigation.

MATERIALS AND METHODS
Wild dogs (n = 87) kept in captivity were presented (n = 83) over the period 1983-1995, either for clinical examination and treatment or for necropsy. For those dogs (n = 4) not presented to us, histories, clinical signs and the results of post mortem examinations were provided to us by veterinarians. The majority of cases originated from a captive breeding unit where pairs or small groups of wild dogs were kept in adjoining enclosures which allowed visual but no physical contact. Two groups were held in enclosures further apart which made visual and physical contact with other groups impossible. These dogs were vaccinated against canine distemper on occasion as described, dewormed at irregular intervals with a broad-spectrum anthelmintic and ectoparasites were controlled by spraying with insecticidal agents. No physical contact with domestic dogs was possible, although domestic dogs were kept within 500 m of the enclosures. The histories of cases were obtained as far as was possible. Physical examination of dogs necessitated prior immobilisation. In a few cases special investigations, including examination of skin biopsy specimens, radiographic examination, ultrasound examination, haematology and blood chemistry, were conducted. Dogs for post mortem investigation were often presented in a moderate state of decomposition, which limited the value of the investigation. Routine comprehensive necropsies were conducted and specimens for histopathological examination were routinely fixed in 10% buffered formalin and histological sections stained with haematoxylin and eosin.

RESULTS
Neonatal deaths
The pups (n = 50) presented for post mortem examination were either abandoned by females within hours or days after birth (most were then found dead in the den) or died after being carried around excessively by their parents shortly after birth. Some of the surviving pups were subsequently removed and attempts were made to hand-rear them. Post mortem examinations revealed the presence of a combination of an acute, diffuse, interstitial pneumonia, a mild neutrophilic meningitis and septicaemia in 8 pups, a mild to moderate, diffuse, subacute interstitial pneumonia in 3 pups, severe purulent pneumonia in 3 pups, and foetal atelectasis in 3 pups (Table 1). The remainder of the pups were too autolysed to detect specific lesions but according to the history of the animals, death was thought to be due to exposure and mismothering. Some of the pups had sucked prior to death.

Trauma
Thirteen cases were presented with lesions caused by trauma. Three 8-month-old pups, 1 male and 2 females, were killed by either one or both of their parents. These pups were part of a litter of 4 removed from the parents shortly after birth and hand-reared. At approximately 3 months of age, the pups were reintroduced to their parents and were apparently accepted without any problems. Two-and-a-half months later the pups were moved to an adjoining enclosure because they were attacked by the male from time to time. The adult dogs subsequently broke into their enclosure, or the pups broke back into the main enclosure but all 3 pups were found dead in the main enclosure. The carcass of the male pup showed severe acute traumatic oedema, haemorrhage and crushing of the ventral neck area as well as a severe acute traumatic diaphragmatic rupture. The carcass of 1 female revealed oedema at the thoracic inlet, traumatised neck...
muscles and traumatic disembowelling through a left inguinal laceration of the abdomen. The spleen, bladder, stomach, large and small intestine were missing. The other female pup had abrasions on all the limbs and laceration of the left inguinal area which exposed ruptured intestines. An acute peritonitis was present and the spleen, urinary bladder and parts of the intestines were missing.

A 3-month-old pup died as a result of complete evisceration by its littermates. No other lesions were evident. A 5-week-old pup (Case 81), from another litter, was in a poor condition, ataxic, had superficial bite wounds primarily on the legs, and scoliosis after it was attacked by littermates (Tables 1, 2). Both these litters were kept in enclosures with no adult dogs present.

A 4-year-old female attacked by another dog died and was presented with moderately advanced subcutaneous haemorrhage of the cheeks, mandibular area, ventral neck, left lateral abdominal wall and inguinal area. An adult female, bitten by another dog, was presented with an open fracture of the distal radius and ulna. The limb was amputated and the dog died in a debilitated state. The spleen, urinary bladder and parts of the intestines were missing.

A 15-month-old subadult female was presented with a fracture of the right femur of unknown cause. The fracture was surgically stabilised by intra-medullary pinning and the dog made an uneventful recovery. An adult male, which died instantly after running into a fence, suffered from haemorrhage into the deep cervical muscles dorsal to the 2nd and 3rd cervical vertebrae, severe epidural haemorrhage in the cranial cervical region, subluxation of intervertebral joint C2/C3, and a fracture of the 2nd cervical vertebra. Another adult female was reported to have died of compression of the cervical spinal cord secondary to fractures of the 3rd and 4th cervical vertebrae within 4 days of having run into the bars of a capture cage.

An approximately 10-year-old male in a debilitated state, severely dehydrated with completely worn incisor and premolar teeth and suffering from a large wound on the medial aspect of the left front leg, was presented for euthanasia. A chronic severe myositis of unknown cause was found on histopathological examination of the exposed muscles.

Respiratory disease

Starvation/mismothering with endogenous lipid pneumonia was diagnosed in four 5-week-old pups that died while still with their mother. The carcasses were very emaciated and appeared anaemic. Large numbers of alveolar macrophages were evident. Under the pleura, particularly, alveoli were filled with very large foamy macrophages that contained a brown pigment compatible with lipofuscin. Similar macrophages containing larger amounts of pigment were present in some of the bronchioles. One pup showed hepatic cellular atrophy.

Renal disease

Lesions of the kidneys (Tables 1, 2) were present in 6 (at least 5 of which were old) wild dogs. A 10-year-old male presented for autopsy suffered from a chronic interstitial nephritis. Another old male (exact age could not be established) (Case 5) that died as a result of suspected right heart failure (see below) had a moderate chronic interstitial nephritis. A mild nephrosis was also present in an old male (Case 10) presented in a debilitated state with severe generalised muscle atrophy, worm teeth and pale mucous membranes. This dog also had mild valvular endocarditis and was infected with Ancylosoma caninum. A severe acute nephritis in association with moderate focal chronic interstitial nephritis was diagnosed in an 11-year-old female (Case 13) presented in a debilitated state. The serum concentrations of urea, potassium, creatinine, albumin and total proteins were respectively, 53 mmol/l, 5.5 mmol/l, 797 μmol/l, 27 g/l and 81 g/l. Alpha 2 and beta globulin peaks were evident on an electrophoretogram. A subsequent autopsy revealed kidney and uterine pathology.

Chronic interstitial nephritis in association with neoplasms of the mammary glands, liver and uterus (see below) was diagnosed in a 9-year-old female (Case 25) with serum urea and creatinine concentrations of respectively 88 mmol/l and 525 μmol/l.

Mild focal acute interstitial nephritis was present in an adult male dog (Case 22) that also had suspected bacterial myocarditis (see below).

Cardiac disease

An autopsy on an old male (Case 5) that died of suspected right heart failure revealed a flabby and dilated right ventricle with severe renal and hepatic congestion and mild splenic atrophy. Kidney lesions were also present (see above). Mild chronic valvular endocarditis was present in an old dog (Case 10) that was also infested with hookworm (see above). Suspected bacterial myocarditis and hepatitis (Case 22) were diagnosed in a male dog that also had mild endocarditis of the mitral valve. Escherichia coli was isolated from the liver.

Nephritis (see above) and acute mild diffuse plasma cellular enteritis were also present (Tables 1, 2).
**Table 2: Wild dogs that suffered from atraumatic lesions involving more than one organ system.**

<table>
<thead>
<tr>
<th>Case number</th>
<th>Sex and age or age group</th>
<th>Lesions</th>
<th>Aetiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>81</td>
<td>Male; 5 months</td>
<td>Wounds</td>
<td>Bitten by littermates</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Scoliosis</td>
<td>Traumatic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Diaphragmatic hernia</td>
<td>Probably congenital</td>
</tr>
<tr>
<td>5</td>
<td>Male; &gt;6 years</td>
<td>Chronic interstitial nephritis</td>
<td>The anaemia probably resulted mainly from an</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Valvular endocardiosis</td>
<td>infection with <em>Ancylostoma caninum</em></td>
</tr>
<tr>
<td>10</td>
<td>Male; &gt;6 years</td>
<td>Nephrosis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Generalised muscle atrophy</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Anaemia</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Valvular endocardiosis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ancylostomosis</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Female; 11 years</td>
<td>Acute nephritis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cystic endometrial hyperplasia</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adenomyosis and leiomyoma of the uterus</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Female; 9 years</td>
<td>Chronic interstitial nephritis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adenomyosis of the uterus</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adenocarcinoma of the mammae</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bile-duct adenoma</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Male; adult</td>
<td>Focal acute interstitial nephritis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Myocarditis, hepatitis, enteritis</td>
<td></td>
</tr>
<tr>
<td>85</td>
<td>Female; 6 years</td>
<td>Dystocia</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pancreatic atrophy</td>
<td></td>
</tr>
<tr>
<td>86</td>
<td>Female; adult</td>
<td>Pyometra</td>
<td><em>Actinomyces pyogenes</em> and <em>Streptococcus zooepidemicus</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Granulosa cell tumours</td>
<td></td>
</tr>
</tbody>
</table>

**Pancreatic disease**

Chronic pancreatitis with secondary diabetes mellitus was diagnosed in a mature dog of unknown age that died and had glucosuria, a blood glucose concentration of 12.9 mmol/l and an elevated serum urea concentration. The pancreas was severely atrophied and on histopathological examination, only small foci of pancreatic tissue with a mild to moderate neutrophil infiltration were present in a connective tissue stroma. Marked fatty infiltration of the liver was present.

Diabetes mellitus was also suspected in a 10-year-old dog that died with extensive fibrosis of the pancreas with obliteration of the islets of Langerhans. An adult female, approximately 4 years of age, died after having an increased blood glucose concentration. At necropsy an acute pancreatic necrosis and fatty infiltration of the liver were found.

A 6-year-old female, in poor condition with a history of a good appetite and producing pale grey foul-smelling faeces, was euthanased approximately 8.5 months after she had a panhysterectomy (Case 86, see below). Post mortem investigation revealed complete loss of body fat reserves, marked pancreatic atrophy, severe fatty infiltration in the liver and glucosuria. The dog probably suffered from both endocrine and exocrine pancreatic insufficiency.

**Uterine disease**

A 9-year-old female (Case 25) with kidney lesions (see above) also had adenomyosis of the uterus, adenocarcinoma of the mammae and a well-differentiated bile-duct adenoma. Marked cystic endometrial hyperplasia with adenomyosis and leiomyoma of the uterus were diagnosed in an 11-year-old female (Case 13) that died of kidney failure. An adult female (Case 86) presented in a collapsed state with a haemorrhagic foul-smelling vaginal discharge was diagnosed as suffering from pyometra by urocentesis and ultrasound examination of the abdominal cavity. Post mortem examination confirmed a severe pyometra and *Actinomyces pyogenes* and *Streptococcus zooepidemicus* were isolated from brain and uterine samples. This bitch also had granulosa cell tumours in both ovaries (Tables 1, 2).

An adult bitch of unknown age, reported to have suffered from foetal dystocia, died shortly after a caesarian section was performed and 13 pups removed.

A third 5-year-old pregnant female (Case 85) was observed outside the den lifting her tail and having abdominal contractions. The contractions initially were observed to occur every 15–20 minutes. Twelve hours later and after delivery of 2 pups only, she was still showing signs of distress and a caesarian section (a panhysterectomy was also conducted) was performed. A large pup was found stuck in the birth canal and a further 7 pups were removed from the uterus. Five pups were dead and 3 died shortly after delivery. The bitch made an uneventful recovery but was euthanased later while suffering from pancreatic atrophy (see above).

**Intestinal disease**

Coccidiosis was diagnosed in a 2-month-old pup that died after having suffered from a severe diarrhoea. *Ancylostoma* was diagnosed as the cause of death in a 2-month-old pup. *Ancylostoma caninum* parasites were found in the intestine of an adult bitch (Case 86) presented in a collapsed state with a pyometra and granulosa cell tumours. A 6-month-old pup was presented with a rectal prolapse. There was no history of diarrhoea and a faecal flotation was negative for worm eggs and coccidial oocysts. The prolapsed rectum was successfully replaced.

A congenital diaphragmatic hernia (with a large portion of the stomach present in the thoracic cavity) was diagnosed in an 8-week-old pup that died approximately 1 week after it was attacked by its littermates. Radiological examination confirmed a hiatal hernia. On autopsy, the carcass was severely cachectic, portions of the lung were collapsed and severe enterorrhagia was evident in the intestinal tract. Histopathological examination of the intestinal tract showed several...
eosinophilic intranuclear inclusions in the epithelial cells. Immunoperoxidase staining for canine distemper virus on these sections was negative.

After transporting a 3-year-old female from one breeding establishment to another, she progressively showed signs of distress such as partial to complete anorexia, listlessness, hoo-calling at night, and no interaction with the male. Five days after the translocation, she developed a severe haemorrhagic frothy diarrhoea and was immobilised for further investigation. She was found to be anaemic (PCV: 14.4 \text{ l/d}) and severely infested with fleas. *Clostridium perfringens* and *Salmonella typhimurium* serotype 4.12: i : 1.2 were cultured from the faeces. She fully recovered after specific and symptomatic treatment. Two months later she successfully mated and 64 days later 4 apparently healthy and normal looking female pups were found dead in the night room. The pups were dry and well cleaned by the mother. The lungs of these pups were never infiltrated. *Salmonella* spp. could not be isolated from their internal organs.

### Skin disease

An infection with an atypical *Trichophyton mentagrophytes* was diagnosed in 2 adult dogs with diffuse severe generalised alopecia. Histopathological examination of skin biopsies revealed acanthosis, hyperkeratosis, hyperpigmentation and atrophy of sebaceous glands. Fungal hyphae could not be demonstrated on histological examination but the organism was isolated by skin culture. The lesions responded favourably to topical antifungal treatment.

### Neoplasms

Apart from the mammary, uterine, ovarian and gall bladder neoplasms mentioned above, a 7-year-old female with extremely worn teeth and in an emaciated condition was presented with an ameloblastoma manifesting as a large sub-spherical firm swelling at the level of the carnassial tooth root. The swelling was covered by intact skin with the exception of a small single ulcer on the outer surface.

### Behavioural disorders

An approximately 6-month-old, hand-reared, tame female was presented for examination because of a suspected ear lesion. The dog was, however, found to show a stereotyped behavioural pattern, evidenced by excessive crying and whining as well as repeated ear scratching movements while lying down in lateral recumbency, when approached by humans.

### DISCUSSION

The majority of dogs (60.2 \%) presented for examination were neonates which probably reflects a high mortality rate for neonates in captive groups of wild dogs. Such a high mortality rate has previously been described for a captive population of wild dogs. A very low survival rate ranging from 25 to 33 \% has also been reported for free-ranging wild dog pups. The causes of the high mortality rate could probably be correlated with the reasons for the abandonment of litters by females shortly after birth. It is beyond the scope of this investigation to discuss these reasons, but social insecurity of females as well as intraspecific aggression may play a significant role. A high mortality rate in pups of lower-ranking females should probably be regarded as a normal population control mechanism. The subsequent hand-rearing of abandoned pups is unlikely to be a worthwhile salvage procedure because of the difficulties involved in preventing imprinting on humans. Markedly abnormal behavioural patterns were observed in the hand-reared pup reported in this paper and in a pup reported by Van Heerden which demonstrated tail-chasing.

It is unfortunate that the ages of adult dogs in this investigation could in most instances not be verified. Like domestic dogs, there does, however, appear to be a tendency for older wild dogs to be more prone to the development of organ diseases, like chronic renal disease, and neoplasia. Trauma appears to be an important cause of disease and mortality in captive populations. Aggression between dogs resulting in fatal wounds primarily directed at the cervical and abdominal areas. Similar fatal cervical and abdominal lesions were previously described for captive wild dogs. Bites on the cheeks, throat and face are probably indicative of uninhibited aggressive behaviour, while abdominal wounds may be indicative of a mob attack. The killing of 3 littermates by their parents had elements of both, with the male pup primarily killed in an uninhibited aggressive way and the females by disembovelling. The 3-month-old dog killed by its littermates is probably a classical example of a mob attack which is usually initiated when there is a behavioural change that may be brought about by disease. The pup with the congenital diaphragmatic hernia is probably another example. Secondary (traumatic) lesions may often mask primary lesions which may complicate the determination of what triggered the mob attack.

The presence of lesions in the kidney, uterus, heart, lungs, intestine, pancreas and liver clearly demonstrates the susceptibility of the wild dog to a wide range of conditions. Excessive dental attrition is probably under-represented in this report as captive dogs 5 years and older often show clear evidence of dental wear (Van Heerden, unpubl. obs.). Further investigation of dental disease in captive wild dogs is long overdue.

Wild dogs are probably prone to the development of most of the conditions encountered in domestic dogs. As is often the case in domestic dogs, we were unable to establish the aetiology of most of these conditions. Complete absence of the most common infectious diseases of domestic dogs in wild dogs reported here is worth noting. Most of these dogs came from an area where canine babesiosis, canine ehrlichiosis and canine distemper are very common. The occasional vaccination, deworming and ectoparasite control on wild dogs and the regular vaccination and deworming of domestic dogs within the immediate vicinity of the wild dog enclosures might have been an adequate preventative disease control measure.

Although the conditions described in this investigation may occur in free-living wild dog populations, they are unlikely to have a major affect on such populations. Infectious diseases such as rabies, anthrax and canine distemper, which may reach epidemic proportions, are probably more likely to have devastating effects on free-ranging populations.

The following broad guidelines should be considered as disease-preventative measures for captive populations:

1. **Wild dogs should be kept in the largest possible enclosure, preferably natural veld, which should include a well-shaded area, a shallow pond and a den. The den should simulate a natural den as closely as possible. A classical concrete overnight room as is found in most zoological gardens is not acceptable.**
2. **Dogs should be fed a diet as close to a natural diet as possible and should therefore preferably be fed parts of entire carcasses of herbivores, inclusive of the internal organs. Water should be available at all times.**
3. **New introductions into an existing group of animals, as well as removing and subsequently returning an animal to the group after any period of time, should be avoided.**
4. **Multi-female groups are likely to result in fatal aggression during peak oestrus periods and pregnancy, and**
such females should be removed unless a pack situation where emigration is possible, is to be maintained. Lower-ranking females are likely to lose their pups should they succeed in falling pregnant and giving birth to pups.

5. Facilities for handling and darting wild dogs should be constructed in such a way that excessive chasing and running is prevented by the incorporation of e.g. small areas that can be closed by remote control. A capture cage or crush at one end of this area is very useful for minor procedures.

6. Different enclosures on the same property should be as far apart from one another as is possible to reduce visual and auditory contact.

7. Ectoparasite control, deworming and vaccination should be practised only as needed. It should be remembered that the commonly available commercial vaccines are prepared for use in domestic dogs and that they are potentially lethal to wild dogs. Vaccination of wild dogs with killed vaccines is recommended.

8. Hand-raising of abandoned pups should be avoided. Newborn pups could be fostered onto another bitch with similar-aged pups but care must be taken not to exceed a litter size of approximately 8.

9. It is important that contact with domestic dogs should be prevented. Disease control measures should be enforced in domestic dog populations and around properties where wild dogs are kept.

ACKNOWLEDGEMENTS
We thank the Department of Pathology, Faculty of Veterinary Science, Medical University of Southern Africa, as well as Drs Stella Bastianello, Ray Jeppe, Joyce Pearson and G J Scheepers for allowing us to use some of their data on wild dog deaths.

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