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A REVIEW OF DISEASES OF PARASITES OF THE KAFUE LECHWE (*KOBUS LECHE KAFUENSIS*)

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ABSTRACT: The diseases of the Kafue lechwe (*Kobus leche kafuensis*) are reviewed in this paper. Kafue lechwe are an important natural resource for Zambia. Bovine tuberculosis is widespread within the lechwe population and they are host to many parasites, especially the warble *Strobiloestrous vanzyli*.

Key words: *Kobus leche kafuensis*, bovine tuberculosis, *Mycobacterium bovis*, endoparasites, *Strobiloestrous vanzyli*, ectoparasites, review.

INTRODUCTION

Kafue lechwe (*Kobus leche kafuensis*) are found in the natural state only within the Kafue Flats area of Zambia. The 65,000 lechwe (Howard et al., 1988) are a "natural resource of national importance" for Zambia (Vesey-Fitzgerald, 1965). They are utilized as a source of meat, hides and trophies. They are important as a tourist attraction and in maintaining the fertility of the Kafue river flats and fisheries (Mitchell and Uys, 1961; Howard, 1977). Lechwe have been domesticated (Bainbridge, 1970) and are being stocked onto game farms in Zambia. In the past lechwe were cropped for meat by traditional kills (Ansell, 1955) and controlled culling, utilizing an abbatoir, was carried out for a short period in the late 1960's (Bainbridge, 1970; Pullan, 1983).

This review is to provide veterinarians and biologists with information on the diseases and parasites of Kafue lechwe.

INFECTIOUS DISEASES

Tuberculous lesions of bone were found in a Kafue lechwe (Leroux, 1958) and pulmonary tuberculosis caused by *Mycobacterium bovis* has been diagnosed in lechwe (Gallagher et al., 1972; Macadam et al., 1974; Clancey, 1977). The prevalence of tuberculosis in lechwe has varied (Table 1) but recent work would indicate that about 16% of adult male animals are affected (Stafford et al., 1990). Lechwe are semi-aquatic animals living in large groups which become concentrated during the rains and early dry season (November to June) when their range is flooded (Gallagher et al., 1972). Crowding is important in the transmission of tuberculosis (Thoen and Hines, 1981) and Sayer and Van Lavieren (1975) speculated that the disease spread when the lechwe were concentrated at the beginning of the dry season and were suffering from "nutritional stress" (Gallagher et al., 1972). There are few predators in the area inhabited by the Kafue lechwe. Gallagher et al. (1972) estimated that tuberculosis killed 20% of the lechwe population each year and may be the major factor limiting population growth.

Lechwe are in contact with cattle when they graze together on the fresh grass which grows as the flood recedes. Cattle may have introduced tuberculosis into the lechwe population (Dillmann, 1976; Rottcher, 1976); ≤25% of cattle from the Kafue Flats showed tubercular lesions on meat inspection (Anonymous, 1965) and ≤40% may be affected (Rottcher, 1976). Infected lechwe may introduce the disease to cattle and other game species if they are moved onto cattle-game farms. When lechwe are killed for meat there is a potential public health problem as ≤80% of carcasses may be tuberculous (Macadam et al., 1974; Dillmann, 1976; Krauss et al., 1986). The control of tuberculosis amongst free-ranging lechwe on the Kafue Flats would be extremely difficult. Lechwe being moved

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TABLE 1. Tuberculosis in the Kafue lechwe.

Number examined	Number affected	Percent affected	Reference
125	45	36	Gallagher et al., 1972
300	90	30	Dillmann, 1976
86	29	34	Gallagher et al., 1972
7	7	100[a]	Clancey, 1977
63	33	52	Clancey, 1977
141	46	33	Krauss et al., 1986
41	33	80[a]	Krauss et al., 1986
147	5	3[b]	Krauss et al., 1986
92	15	16	Stafford et al., 1990

[a] Cachectic animals with suspected tuberculosis.
[b] Dead animals collected from Kafue Flats.

onto game farms could be tested for tuberculosis; however the efficacy of testing lechwe for tuberculosis either by skin testing (Macadam, 1973) or serological testing is unknown. Tuberculosis was not a problem among Black lechwe (*Kobus leche smithemani*); they inhabit an environment similar to the Kafue lechwe but do not come in contact with cattle (Grimsdell and Bell, 1975).

Serological surveys have been conducted to determine the disease status of lechwe (Table 2). Antibodies against brucella organisms, the *Leptospira interogans* serovars *autumnalis autumnalis* and *ballum ballum*, *Pseudomonas pseudomallei*, *Francisella tularensis*, *Chlamydia psittaci*, *Coxiella brunetii*, infectious bovine rhinotracheitis/infectious pustular vaginitis virus, parainfluenza 111 virus and reoviruses 1,11,111 were found in <10% of lechwe (Table 2), Antibodies against bluetongue virus were found in 50% of a small number of lechwe. The significance of these findings to the health of lechwe and domestic animals in contact with them are unclear (Krauss et al., 1986) but may become more obvious as lechwe are moved onto cattle-game farms. Foot and Mouth

TABLE 2. Serological Surveys of Kafue lechwe.

Infectious agent	Number of samples	Results	Reference
Leptospirosis[a]	45	3 positive[a]	K. Stafford (unpubl. data)
Brucellosis[b]	200	positive[f]	Krauss et al., 1986
Brucellosis[d]	55	2 positive[e]	K. Stafford (unpubl. data)
Mycobacterium paratuberculosis	200[c]	all negative	Krauss et al., 1986
Anaplasma marginale	31	all negative	Dillmann, 1976
Anaplasma centrale	31	all negative	Dillmann, 1976
Pseudomonas pseudomallei	200[c]	positive[f]	Krauss et al. 1986
Francisella tularemia	200[c]	positive[f]	Krauss et al. 1986
Chlamydia psittaci	200[c]	positive[f]	Krauss et al. 1986
Coxiella burnetti	200[c]	positive[f]	Krauss et al. 1986
Infectious Bovine Rhinotracheitis	10[c]	positive[f]	Krauss et al. 1986
Parainfluenza 111	10[c]	positive[f]	Krauss et al. 1986
Reovirus 1, 11, 111	5[c]	positive[f]	Krauss et al. 1986
Bluetongue	10	5 positive	Krauss et al. 1986
Babesia bigemina	31	all negative	Dillmann, 1976
Theileria parva	31	all negative	Dillmann, 1976
Theileria mutans	31	all negative	Dillmann, 1976

[a] The microagglutination test was used to test for antibodies against the following serovars: *Leptospira interogans* serovar, *canicola canicola*, *icterohaemorrhagiae copenhageni*, *pomona pomona*, *grippotyphosa grippotyphosa*, *tarrasovi tarrasovi*, *australis australis*, *australis bratislava*, *sejroe hardjo*, *hebdomadis hebdomadis*, *mini mini*, *bataviae bataviae*, *javanica javanica*, *pyrogenes pyrogenes*, *autumnalis autumnalis*, *ballum ballum*, *celledoni celledoni*, *cynopteri cynopoteri* and *shermani shermani*. Three were positive for *autumnalis autumnalis* and one for *Ballum ballum*.
[b] Serum agglutination test.
[c] The exact number tested was not stated.
[d] Rose Bengal test and slide agglutination test.
[e] Positive to both tests (d).
[f] The exact number of positive sera was not stated.

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TABLE 3. Nematode parasites of Kafue lechwe.

Oesophagostomum lechwei	(Leroux, 1955)
Bunostomum cobi	(Leroux, 1958)
Bunostomum sp.	(Leroux, 1932)
Trichostrongylus colubriformis [a]	(Leroux, 1930)
Haemonchus bedfordi	(Leroux, 1955)
Haemonchus contortus [a]	(Leroux, 1930)
Cooperia curticei	(Leroux, 1932)
Dictyocaulus filaria	(Fitzsimmons, 1961)
Dictyocaulus viviparus	(Robinette and Child, 1964)
Thelazia rhodesi	(Robinette and Child, 1964)
Thelazia sp.	(Leroux, 1955)
Onchocerca sp.	(Leroux, 1947, 1955)
Setaria bicoronata	(Yeh, 1959)
Setaria boulengeri	(Yeh, 1959)
Setaria hornbyi	(Yeh, 1959)
Setaria sp.	(Leroux, 1955)
Trichuris sp.	(Ratcliffe, 1930)

[a] Round (1968) questioned this finding.

TABLE 4. Trematode and cestode parasites of Kafue lechwe.

Fasciola gigantica	(Gallagher et al., 1972; Wright et al., 1979a)
Fasciola sp.	(Leroux, 1957)
Cotylophoron cotylophoron	(Leroux, 1932)
Cotylophoron sp.	(Robinette and Child, 1964)
Carmyerius sp. [a]	(Wright et al., 1979b)
Gastrothylax crumenifer	(Leroux, 1932)
Paramphistomum cervi [b]	(Leroux, 1932)
Gigantocotyle explanatum	(Leroux, 1932)
Gigantocotyle formosanum	(Round, 1968)
Gigantocotyle lerouxi	(Yeh, 1957)
Choerocotyloides onotragi	(Prudhoe et al., 1964)
Homalogaster paloniae	(Leroux, 1955)
Stephanopharynx compactus	(Wright et al., 1979b)
Calicophoron calicophoron	(Wright et al., 1979a)
Schistosoma leiperi	(Leroux, 1955)
Schistosoma margrebowiei	(Leroux, 1933, 1955)
Schistosoma matthei	(Leroux, 1958)
Schistosoma spindalis [c]	(Ortlepp, 1961)
Taenia spp.	(Leroux, 1955, 1957; Robinette and Child, 1964)

[a] May be *C. mancupatus* or *C. spasiosus* (Wright et al., 1979b).
[b] May be *P. microbothrium* or *P. phillerouxi* (Wright et al., 1979b; Round, 1968).
[c] Round (1968) questioned this finding.

disease has not been diagnosed clinically in Kafue lechwe and the causative virus was not isolated from 50 animals sampled by Dillmann (1976). Lechwe are probably succeptible to the disease but their importance as a source of the disease for domestic animals is unknown (Howard, 1977). Heartwater disease caused by *Cowdria ruminantium* was diagnosed in lechwe with heavy loads of *Amblyomma variegatum* ticks held on a game farm (G. S. Pandey, pers. comm.). Abscesses were found in the testes of three lechwe (Robinette and Child, 1964) but the lesions were not examined bacteriologically.

HELMINTH PARASITES

Kafue lechwe are host to many parasites (Tables 3, 4, 5; Round, 1968). The effect of these parasites on lechwe is unknown but Robinette and Child (1964) doubted if internal parasites were primary cause of mortalities. Strongyle nematode eggs were found in 74 of 76 faecal samples taken from recently shot adult lechwe (K. Stafford, unpubl. data). The number of eggs per gram were <100 in 68 of these samples. Coccidial oocysts were found in many of these faecal samples. Coccidia have not previously been reported in lechwe. Lungworms of three different species were found in about 55% of culled lechwe (Dillmann, 1976) but only two species have been definitely identified (Table 3). *Thelazia rhodesi* found in small numbers in a

TABLE 5. Ectoparasites of Kafue lechwe.

Strobiloestrous vanzyli	(Zumpt, 1961; Howard, 1975, 1980, 1985)
Damalinia sp.	(Robinette and Child, 1964)
Amblyomma variegatum	(Colbo, 1973)
Rhipicephalus evertsi	(Colbo, 1973)
Rhipicephalus sanguineus	(Colbo, 1973)
Rhipicephalus appendiculatis	(Robinette and Child, 1964)
Muscoid headflies	(Robinette and Child, 1964)

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few lechwe (Robinette and Child, 1964) may be the filarial worms referred to by Sayer and Van Lavieren (1975) as the cause of blindness in lechwe. *Onchocerca* sp. probably *O. gibsoni* were found in fibrous lesions in periarticular regions especially near the stifle joint (Leroux, 1947, 1955; Robinette and Child, 1964). Approximately 35% of the lechwe in Lochinvar National Park were affected by onchocerciasis which caused lameness in some animals (Dillmann, 1976). *Setaria sp.* were "abundant" in lechwe (Sayer and Van Lavieren, 1975; Robinette and Chile, 1964; Dillmann, 1976) and three species have been identified (Table 3). *Fasciola gigantica* were identified in adult lechwe (Wright et al., 1979a). Female lechwe had a higher prevalence of liver fluke (22%) than males (6%) possibly due to the female habit of grazing more in the marsh along the water's edge (Gallagher et al., 1972). However Fasciola eggs were found in 68 of 76 (89%) faecal samples taken from male carcasses and examined by K. Stafford (unpubl. data). Amphistome flukes were regularly seen in lechwe (Table 4). *Schistosoma margrebowiei* have been found in young lechwe (Leroux, 1933, 1955) and *S. leiperi* in older animals (Wright et al., 1979a; Howard et al., 1982). Lechwe <1 yr of age had a mean infection of 24 *S. margrebowiei* and no *S. leiperi* while adult animals >4 yr of age had a mean infection of 273 *S. leiperi* and no *S. margrebowiei*. One adult lechwe had over 1,000 *S. leiperi* (Howard et al., 1982). *S. matthei* found in lechwe by Leroux (1958) was not identified by Howard et al. (1982) in lechwe sharing pasture with cattle, but was seen in waterbuck (*Kobus defassa*) living remote from cattle.

ECTOPARASITES

The oestrid larvae of *Strobiloestrous vanzyli,* the southern lechwe fly, were found in the subcutis of the back and hindquarters of lechwe (Zumpt, 1961; Sayer and Van Lavieren, 1975; Howard, 1980). In a sample of 526 lechwe of all ages, 95% of those <1-yr-old were affected with warbles ($\bar{x}$ = 149 warbles/animal) while only 20% of older animals were affected ($\bar{x}$ = 8.6 warbles/host) (Howard, 1985). The warbles are on the lechwe from November until September when the prepupae emerge, drop on the ground and pupate in the soil. Adult flies emerge within 1 mo (Howard, 1985). *S trobiloestrous vanzyli* may not be distinct from *S. erikssoni* (Howard, 1980). Leroux (1942) reported finding similar warbles on lechwe and cattle and concluded that they were from the same species of fly. The large numbers of larvae seen on young lechwe led Mitchell and Uys (1961) to conclude that the warbles caused "heavy" mortalities but evidence to support this conclusion is lacking. A small unidentified muscoid fly was seen to be a nuisance to lechwe during the warmer months of October and November. Lechwe sought relief from the fly by rubbing their heads in grass or standing in a tight circle (Robinette and Child, 1964). Lice (*Damalinia* sp.) were common on lechwe (Robinette and Child, 1964). Various species of ticks have been found on lechwe (Table 5) (Ganagarajah, 1976). *Rhipicephalus appendiculatis* was found in small numbers (<5) only on the perianal region of 20 of 75 lechwe examined, the remaining 55 animals had no ticks (Robinette and Child, 1964).

MISCELLANEOUS PATHOLOGICAL CONDITIONS

A fibrosarcoma and other malignant but unidentified neoplasms were found in lechwe by Robinette and Child (1964).

DISCUSSION

The population of Kafue lechwe has dropped from 94,075 in 1970 to 65,000 in 1988 (Howard et al., 1988). This reduction in numbers has been due to a loss in available habitat, poaching and perhaps disease and malnutrition.

Tuberculosis and warbles are the major disease problems of lechwe. Tuberculosis was seen in most cachectic animals ex-

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amined (Table 1). However it was only seen in 3% of 147 autopsies conducted on lechwe found dead (Krauss et al., 1986), the majority had died as a result of poaching injury. The significance of the effect of warbles and other internal parasites on the health of lechwe is unknown. The lameness seen in many lechwe may be due to onchocerciasis and/or poaching injuries.

To maintain the present population of lechwe attempts may have to be made to control tuberculosis. Increasing the available habitat and reducing contact between cattle and lechwe have been suggested as means of reducing mortalities due to tuberculosis and malnutrition (Rottcher, 1976). A suggestion by Dillmann (1976) that the culling of 5,000 lechwe/yr might reduce tuberculosis has not been confirmed. However the present level of tuberculosis is much lower than that seen in the seventies and this might be explained in part by the fact that lechwe numbers droppped to 41,000 in 1982 (Howard et al., 1988). Research should be directed towards examining the accuracy and feasibility of tuberculosis testing of lechwe in the wild, in transit and on game farms. The monitoring of lechwe held on game farms stocking cattle free from tuberculosis may demonstrate whether the disease can be maintained in a lechwe population isolated from tubercular cattle.

The limited number of serological surveys conducted suggests the need to evaluate further the prevalence of antibodies to bluetongue, Rift Valley Fever, Bovine Herpes virus and other diseases within the lechwe population. Lechwe are being moved onto farms which stock domestic ruminants. It is important the the transmission of disease from lechwe to domestic ruminants and vice versa, if it occurs, be monitored. Will the warbles of *Strobiloestrous vanzyli* affect cattle (Leroux, 1942) and *Schistosoma matthei* infest lechwe on cattle-game farms? Disease problems such as heartwater and heavy tick infections not reported from wild lechwe may become problems on game farms. The cropping scheme proposed and supported by the World Wildlife Fund and initiated in 1989 is an opportunity to study further the disease conditions seen in adult lechwe. As the lechwe will be cropped for meat, postmortem examination will have to be carried out to ensure the quality of the meat being sold. Blood obtained from the cropped animals could be used for serological studies. The cropping and farming of lechwe may be necessary to ensure the survival of the species in Zambia. Both these enterprises demand that lechwe are healthy, fit for human consumption and are not a source of disease for other wild and domestic stock held on game farms.

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