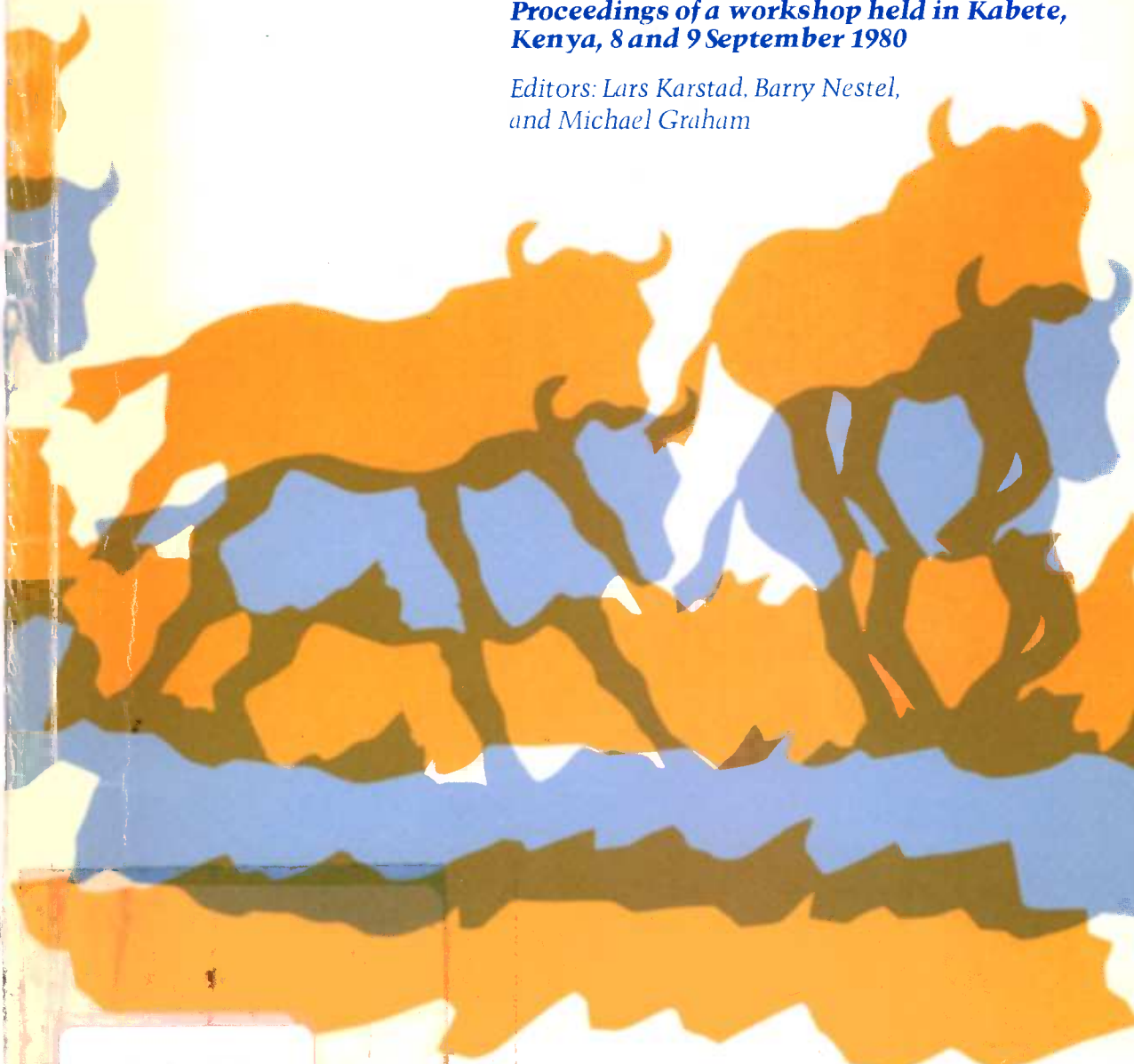


Wildlife Disease Research and Economic Development

*Proceedings of a workshop held in Kabete,
Kenya, 8 and 9 September 1980*

*Editors: Lars Karstad, Barry Nestel,
and Michael Graham*



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The Role of Jackals in the Transmission of *Echinococcus granulosus* in the Turkana District of Kenya¹

Calum N. L. Macpherson² and Lars Karstad³

The causative agent of hydatidosis in Kenya is *Echinococcus granulosus* (Batsch, 1786), which is primarily maintained in a cycle between dogs and domestic livestock (Nelson and Rausch 1963). Recent evidence suggests however that in Masailand, in addition to the domestic cycle, a sylvatic cycle is also operating (Sachs and Sachs 1968; Dinnik and Sachs 1972; Eugster 1978).

Jackals, being scavengers, are attracted to kills made by other carnivores and have every opportunity of becoming involved in a sylvatic cycle. In addition to preying on rodents, birds, and young and small antelopes, especially dik-dik, jackals also frequent the vicinities of manyattas and stock bomas, where they have access to the carcasses of domestic livestock (cattle, sheep, goats, camels, and donkeys), all of which may harbour hydatid cysts. In our experience, silver-backed jackals often feed on larger herbivores, as judged by the presence of bones, skin, and hair in their stomachs; whereas, the stomachs of the golden jackals examined in Turkana often contained mainly insects, including many scorpions.

Jackals have been reported as harbouring the adult parasite (Table 1); therefore, we decided to investigate the role played by the silver-backed jackal (*Thos mesomelas*) and the golden jackal (*Thos aureus*) in the transmission of *Echinococcus* in Turkana District. This district has the highest human incidence rate of the disease in the world (Wray 1958; Nelson and Rausch 1963; Schwabe 1969; Roettcher 1973; O'Leary 1976; African Medical and Research Foundation 1978-80).

The jackals examined for this study came from three separate locations in the north of Turkana District, near Kakuma, Lakonkai, and Lokichogio. In this area, annual morbidity due to hydatidosis is approximately 20 per 10 000 (African Medical Research Foundation 1978-80). This area was also known to support a small population of wild animals.

Four silver-backed jackals were captured from the Loita plains, Narok District, to examine the suitability of this carnivore as a definitive host for the parasite.

The jackals examined in Turkana were usually shot at night using a spotlight. The small intestines were then removed in toto, placed into labelled plastic bags, and stored in a refrigerator overnight.

After rinsing the intestine in normal saline, the gut was opened under fresh saline in large black-bottomed trays. If no *Echinococcus* were observed in this initial inspection, the mucosa was scraped and the scraping was washed and decanted several times with fresh saline. If *Echinococcus* were observed in the washings, they were placed in a petri dish of saline and allowed to relax for up to an hour. The number of worms recovered was estimated and the worms were fixed in either 70% alcohol, as recommended by Vogel (1957), or in 10% formol saline. Objects, which appeared on gross inspection to be either whole worms or segments of *Echinococcus*, were kept for microscopic examination. The specimens were stained in Gower's carmine and mounted in toto.

Experimental Infection of Silver-Backed Jackals

On the basis of finding infected silver-backed jackals in Turkana and reported infections from elsewhere (Nelson and Rausch 1963; Verster and Collins 1966; Eugster 1978), we artificially infected

¹This paper was introduced by a well-illustrated oral presentation by Dr I. Mann, FAO/UNEP/WHO, Box 20360, Nairobi, Kenya.

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Table 1. Prevalence of *Echinococcus granulosus* in jackals in Africa (positives only).

Number examined	Positive		Country	Author
	Number	%		
<i>Silver-backed jackal</i>				
1 ^a	1	100	Kenya	
9	1	11.1	Kenya	Nelson and Rausch (1963)
13	5	38.5	Kenya	Eugster (1978)
215	21	9.7	South Africa	Verster and Collins (1966)
<i>Golden jackal</i>				
82	1	1.2	Chad	Troncy and Graber (1969)

^aUnidentified species.

four silver-backed jackals to further assess the suitability of these carnivores as definitive hosts for the parasite and to compare the infections produced in them with a control group of puppies.

The silver-backed jackals were captured from the Loita plains, Narok District. Prior to infection, each animal received 10 mg/kg body weight of praziquantel (Droncit (R), Bayer, Leverkusen, Germany). A few months later the jackals were fed a gelatin capsule containing 0.2 ml of packed protoscoleces obtained from hydatid cysts removed surgically from two Turkana patients. Prior to infection, the material was checked for viability by examining flame cell activity, evagination, and the uptake of vital stains. No material was used with an average viability of less than 60%. The same material was fed to five puppies, and all animals were examined post mortem 40 days later. Some of the worms obtained from the artificial infections were used for examining the isoenzyme glucose phosphate isomerase (GPI) employing the method recommended by McManus and Smyth (1979).

Results

Jackals Examined in Turkana

A total of 60 jackals were examined from the three locations in northern Turkana: of these, 28.3% were found to harbour the adult parasite (29% of the silver-backed jackals and 27.3% of the golden jackals). The golden jackals were obtained from Kakuma (1, negative), Lakonkai (12, negative), and Lokichogio (9, 6 positive). The silver-backed jackals originated from Kakuma (1, negative) and Lokichogio (37, 11 positive) (Table 2).

The morphological data obtained from the golden and silver-backed jackals were compared with material from naturally infected dogs from the same area. The material we collected corresponded

closely with that of Nelson and Rausch's (1963), material that was collected in Kenya and accepted as being *Echinococcus granulosus*.

Table 2. Jackals examined for *Echinococcus* in Turkana.

	Silver-backed	Golden
No. animals examined	38	22
Light infection (<200 worms)	7	6
Medium infection (200-1000 worms)	1	0
Heavy infection (>1000 worms)	3	0

Experimental Infections of Silver-Backed Jackals

Unfortunately the results of this experiment were rather disappointing; only one of the jackals and one puppy became infected. However, both of these animals harboured very heavy infections, numbering some 4000 and 7000 worms, respectively. The location of the worms was similar in both animals, the small intestine being "furred" with worms from 54 to 72 cm back from the pylorus in the jackal and from 36 to 76.5 cm in the puppy.

The zymograms obtained for glucose phosphate isomerase (GPI) following isoelectric focusing of the soluble extracts of some of the worms from the experimental infections were found to be identical (Fig. 1). This suggests that the silver-backed jackal, as a different definitive host to the dog, does not appear to alter the electrophoretic pattern produced for this particular isoenzyme. Further experiments on jackals and puppies, using different isoenzymes, are required to confirm this preliminary observation.

Discussion

This is the first time that golden jackals have been recorded as definitive hosts of *E. granulosus* in Kenya. The first record of these animals harbouring

this parasite was made over 100 years ago by Panceri (1868) in Naples. Since then, natural infections in *T. aureus* have been reported from Palestine (Witenburg 1933), Pakistan (Lubinsky 1959), Algeria (D'Arces 1953), Sri Lanka (Dissanaike and Paramanathan 1960), in the Beka'a valley of Lebanon (Daily and Sweatman 1965), and in Chad by Troncy and Graber (1969), who found one infected jackal in the 82 they examined.

Although we found a high percentage (27.3%) of golden jackals harbouring *E. granulosus*, the greatest number of worms recovered from any one infection was 44, and the number of worms from the other five infections totaled only 22. In comparison to some of the silver-backed jackal infections, these were very light infestations indeed. No gravid segments were seen in the golden jackal material, although in other respects the worms showed normal development and all possessed testes. Daily and Sweatman (1965) reported that the single infected golden jackal they examined had two whole worms and three proglottids that were gravid, illustrating that although this was a low infection the parasite can achieve the gravid state in this host.

Of the 11 infected silver-backed jackals we discovered, three harboured in excess of 1000 parasites. The majority of the worms had gravid terminal segments, containing hundreds of shelled eggs, with

the uterine lateral sacculations well developed. The first report of a natural infection in silver-backed jackals was by Nelson and Rausch (1963) who, in Kenya, found one of nine silver-backed jackals infected. In an extensive survey in South Africa, Verseter and Collins (1966) found 21 of 215 (9.7%) silver-backed jackals to harbour the parasite and recently Eugster (1978) reported 5 of 13 (38.5%) infected in Kajiado District (Kenya). Three of the five positive animals reported by Eugster had worm burdens of greater than 20 individuals.

Viljoen (1937), working in South Africa, noted that silver-backed jackals could support the parasite and produced an experimental infection numbering a few thousand parasites. This, together with our own experimental observations, shows that the silver-backed jackal is a potentially good definitive host of *E. granulosus*.

The reasons as to why only one jackal and one puppy became infected are unclear, but the heavy infections produced in the jackal and puppy provide evidence that these animals are readily susceptible to infection with protoscoleces of human origin. This factor may have an important bearing in the epidemiology of the disease in Turkana and Masailand. The Masai only bury their dead when they have settled near townships, and the Turkana only bury respected old men and married women with children; others who die are simply left in the bush to be eaten by carnivores and scavenging birds such as vultures and Marabou storks. Wegener and Gathuma (1975) proved experimentally that the Marabou stork plays no part in the spread of *Echinococcus*. However, our experimental evidence shows that if either domestic dogs or silver-backed jackals were exposed to human hydatid cysts they could become infected. There is therefore the possibility that some of the infections found in these animals may have originated from the people themselves. This may be especially valid in Turkana District because the people have such an extraordinarily high prevalence of the disease. Therefore, in these areas man may not be the dead-end hosts, as in most other regions of the world. Undoubtedly the majority of the jackal and dog infections arise from scavenging of domestic livestock carcasses. There was ample evidence for this in Turkana after the recent drought. The skeletal remains of dead livestock, particularly cattle, were seen in thousands along all the roads and around the watering points.

The jackals may in turn be causing some infections by fouling waterholes used by the people and their livestock. Such waterholes are easily accessible to jackals, which visit them during the night.

One unusual route of transmission from jackals to humans is the eating of infected jackal intestines. The Turkana regard the intestines of most animals



Fig. 1. Zymogram obtained from soluble extracts of *E. granulosus* tapeworms from a dog (D) and a silver-backed jackal (J) experimentally infected with protoscoleces from a Turkana patient, for the enzyme glucose phosphate isomerase (GPI). Hb represents a hemoglobin control.

as a great delicacy and would have consumed the small intestines of the jackals we had examined had they been permitted. However, they had to content themselves with the animals without that part of their anatomy.

Control

Recent studies have revealed that, in addition to the domestic cycle, there is strong evidence of a sylvatic cycle operating in Masailand (Sachs and Sachs 1968; Dinnik and Sachs 1972; Schiemann 1971; Eugster 1978; Macpherson et al. 1980). The presence of this sylvatic cycle will obviously complicate the planning of a control program for this area.

However, because the human incidence of the disease in Masailand is only 1–2 per 100 000 per year (Eugster 1978), such a program, although desirable, is not of such a high priority as it is in Turkana. In Turkana, jackals are the only wild animals to be found harbouring the disease. Of 154 wild herbivores (Grant's gazelles, warthogs, dik-diks, hares and squirrels) and 16 spotted hyenas examined in the District none were found to harbour the parasite (Macpherson et al. 1980). The main transmission of the parasite therefore is through a dog–livestock cycle. With the absence of a true sylvatic cycle, the problem of control of the disease in Turkana is much simplified and initial efforts for control should be aimed at the dog–livestock cycle. Reduction of the infection rate in domestic animals should suppress the jackal infection rate automatically, and no special measures of control need be applied to the wild animals.

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