

A dog ecology study in an urban and a semi-rural area of Zambia

K.K.I.M. DE BALOGH¹, A.I. WANDELER² and F.-X. MESLIN³

ABSTRACT

DE BALOGH, K.K.I.M., WANDELER, A.I. & MESLIN, F.-X. 1993. A dog ecology study in an urban and a semi-rural area of Zambia. *Onderstepoort Journal of Veterinary Research*, 60:437-443

Characteristics of dog populations and their accessibility for rabies vaccination were compared in an urban and a semi-rural area in Zambia. A total of 1 190 households were interviewed. In the urban study area (Mutendere, a low income suburb of Lusaka) only 11% of the households kept dogs with a dog:human ratio of 1:45. In the semi-rural area (Palabana) dogs were kept by 42% of households with a dog:human ratio of 1:6.7. In conjunction with the study of the dog populations in these two areas, immunization of dogs against rabies was provided by door-to-door visits in both study areas and also through central point vaccination in the urban area. The attitude of the public towards free rabies vaccinations was positive, although some misconceptions regarding indications and modalities of treatment following exposure to suspect dogs were found.

Approximately 50% of the dog removals were as a result of disease and the demand for dogs was higher than the supply. Although only information on the owned segment of the dog population was obtained during the study, the proportion of ownerless dogs appeared to be very low. Generally, there is a need for better co-ordination between the different services involved in rabies control in Zambia to enhance the sustainability of vaccination programmes and improve the treatment of persons bitten by dogs.

INTRODUCTION

In most parts of southern Africa rabies in dogs and wildlife is a problem of increasing magnitude. In 1988, the World Health Organization (WHO) reported that dogs were responsible for 92% of human deaths due to rabies in Africa (WHO 1989). The systematic control of rabies in dogs has often not been

adequately implemented for a variety of reasons such as insufficient funding and logistic and management problems within the organizations responsible for rabies control. Low turn-up during vaccination campaigns and opposition on the part of the community to dog removal programmes have hampered the implementation of rabies control programmes as they have frequently been unacceptable for cultural reasons or were ecologically inappropriate (Beran & Frith 1988).

In Asia, Latin-America and northern Africa, dog ecology studies have proven to be a valuable tool for the design of appropriate rabies control programmes (Beran 1982; WHO 1987; Beran & Frith 1988; Wandeler, Budde, Capt, Kappeler & Matter 1988; WHO 1988).

¹ Department of Clinical Studies, School of Veterinary Medicine, University of Zambia, Lusaka, Zambia

² Rabies Unit, Animal Diseases Research Institute, 3851 Chemin Fallowfield Road, Nepean, Ontario, K2H 8P9 Canada

³ Veterinary Public Health Unit, World Health Organization, Geneva, Switzerland

In Zambia, rabies is an endemic disease and constitutes a serious public health problem (Hussein, Sharma, Ando & Chizyuka 1984). Since only limited dog population data is available for sub-Saharan Africa, the WHO initiated and supported financially, together with the Netherlands Development Co-operation, a dog ecology study in Zambia. The purpose of this study was to compare the dog keeping practices and the dog population characteristics as well as accessibility for parenteral vaccination against rabies of two localities; one in a low income urban setting and the other in a semi-rural area.

This dog ecology study laid the basis for a massive rabies vaccination campaign of dogs in the low and medium income areas of Lusaka. By means of an intersectoral approach, over 9000 dogs were immunized with very limited resources over two days in September 1992.

MATERIAL AND METHODS

Study areas

Mutendere, the most densely populated compound of Lusaka (total population > 70 000, population density = 294 persons/ha) and Palabana, a semi-rural village with approximately 600 inhabitants located 30 km East of Lusaka, were selected as study areas.

In Mutendere, interview/vaccination teams were assigned to different locations in the compound from where they visited every household in preselected blocks. In Palabana a comprehensive survey of all the households was conducted.

Questionnaires

A questionnaire survey of each household visited, adapted from WHO suggested dog ecology survey questionnaires (WHO 1987; 1990), aimed at obtaining data on the number of persons living in households, their ethnic background, dog keeping practices and "removal" of dogs during the last 12 months. Dogs were classified as "removed" if they had lived in the household within the last 12 months but were no longer living there and an attempt was made to establish the fate of these animals, i.e. if they had died of disease, had been killed, given away or sold or had just "disappeared". If no dogs were kept in the household the reasons for this were inquired. A further question referred to the number of persons bitten by dogs in the last 12 months and the treatments applied. Additionally, a questionnaire for each dog in the household was used to obtain data on the age, sex, condition and vaccination status of dogs in the household. For females the number of litters, number of puppies of the last litter, as well as what happened to these puppies was recorded.

Vaccination strategy

Dogs in interviewed households were vaccinated against rabies during the visit (as long as the age, health status and date of last rabies vaccination made them eligible for the inoculation). In the urban study area the door-to-door vaccination campaign was followed one week later by a one-day central point vaccination at three schools in the compound. The central point campaign was preceded by a limited information campaign over the radio and by mobile loudspeakers.

Re-observation of dogs

At the time of vaccination dogs were collared to enable subsequent assessment of the vaccination coverage achieved by re-observation of collared dogs. The re-observation of dogs two days after the door-to-door campaign in both study areas was carried out on foot in the morning (after 10:00) and in the late afternoon.

Two days after the central vaccination campaign in Mutendere a further re-observation was carried out to assess the vaccination coverage of the compound.

RESULTS

During the dog ecology study a total of 1 190 households were interviewed: 1 105 in Mutendere (urban) and 85 in Palabana (semi-rural). In Mutendere, as in most compounds in Lusaka, all the houses were one storey buildings with often several households living in different parts of the same house. The houses in Palabana varied from concrete, medium cost, one storey houses to traditional mud huts.

The households

Approximately 13% of the total households in Mutendere and all the households in Palabana were interviewed.

In Mutendere the respondents came from 30 and in Palabana from 12 different tribal origins. When correlating tribal origin and dog keeping, no association could be established.

Data on the households and on the dog population of both study areas is presented in Table 1.

There was a significant difference ($P < 0,05$) in the proportion of households that kept dogs between the two study areas. However, the reasons given by the respondents of households without dogs did not vary significantly between the urban and semi-rural areas. Over 35% of the respondents from households without dogs claimed to dislike them. For example, some respondents characterized them as dirty, noisy and transmitters of diseases. Around 30% did not give any specific reasons for not keeping dogs or merely

TABLE 1 Characteristics of dog populations in Mutendere and Palabana

Characteristic	Mutendere	Palabana
Number of interviews	1 105	85
Average number of persons per household	7,53 (s = 3,97)	6,83 (s = 4,09)
Number of dogs in interviewed households	187	87
Number of households keeping dogs	128 (11%)	36 (42%)
Dog:human ratio	1:45	1:6,7
Average number of dogs per household	0,12	1,02
Average number of dogs per household with dogs	1,5	2,4
Median age of dogs (years)	2	1
Number of male dogs	102	37
Number of female dogs	87	50
Sex ratio male:female	1,17:1	0,74:1
Proportion of puppies of dog population	9%	34%
Average number of litters	1,03 (s = 1,59)	0,88 (s = 1,17)
Average litter size	5,7 (s = 2,9)	5,2 (s = 1,2)

stated that they were not interested in keeping them. Financial reasons and the absence of a fence (especially in Mutendere) as well as the shortage in supply of dogs were also given as reasons for not keeping dogs.

In Mutendere 54 % of the dogs were never, and 15 % only irregularly, leashed or shut in. Nineteen percent of the dogs in Mutendere were confined day and night and the remaining 12 % either during the day or night. In Mutendere 9 % of the houses had a fence able to restrain a dog. A significant difference ($P < 0,01$) was observed between the number of households keeping dogs living in fenced-in areas and those without any means of restraining dogs. Four-times as many households in possession of a restraining fence kept dogs as those without a fence. In Palabana none of the houses had a fence capable of restraining a dog and only one dog was indicated to be confined during the day.

The majority of the dogs observed during the study were medium sized and of mixed breed. Although in Mutendere 54 % of the dogs were male as compared to only 43 % of male dogs in Palabana, this difference was not statistically significant ($P < 0,05$). On the other hand, there was a statistically significant difference ($P < 0,01$) between the proportion of the dog population under three months of age between the two study areas; 9 % of all dogs in Mutendere compared to 34 % in Palabana were puppies.

Reproduction

Little information on the reproductive capacity of bitches was obtained because only few respondents knew the number of litters/bitch.

In Mutendere 50 % of the bitches had their last litter within the last six months while the figure for Palabana was 30 %.

TABLE 2 The fate of puppies from the most recent litters of bitches in the Mutendere and Palabana study areas

Destiny of dogs	Mutendere		Palabana	
	n	%	n	%
Still living in the household	17	7,9	14	17,9
Given away/sold	68	31,6	21	26,9
Killed	18	8,4	0	
Died	112	52,1	43	55,1
Total	215	100	78	100

Data on 215 puppies representing the most recent litters of bitches in households in Mutendere and on 78 puppies in Palabana are presented in Table 2.

Removals (i.e. disappearance) of dogs over three months of age

From the households interviewed, the number of dogs over the age of three months "removed" from the households interviewed during the last 12 months is indicated in Table 3. No dogs were reported to have died from rabies within this period in any of the households interviewed. However, in Mutendere over 50 % and in Palabana 40 % of the dog removals were attributed to disease by the respondents. The proportion of dogs sold or given away was significantly higher ($P < 0,05$) in Palabana than in Mutendere.

The condition score (good, fair/poor or emaciated) was indicated by the interviewer for the dogs present in each household. In Mutendere, 74 % of the dogs

TABLE 3 Adult and juvenile dog removals during the previous 12 months in Mutendere and Palabana

Destiny of dogs	Mutendere		Palabana	
	n	%	n	%
Given away/sold	17	10	13	43
Killed by man	39	24	4	13
Killed by traffic	11	7	1	3
Died of rabies	0	—	0	—
Died of disease	85	52	12	40
Disappeared	11	7	0	—
Total	163	100	30	100

were in "good" condition while 4 % were characterized as being emaciated. The remaining dogs were in fair to poor condition. In Palabana 60 % were in good condition and 10% described as emaciated. In both areas ticks were present on 30 % of the dogs.

Vaccination status of dogs

In Mutendere 68 of 160 dogs (42,5 %) older than three months were said to have been vaccinated previously. However only 26 (16 %) out of the 160 dogs had been vaccinated within the last 12 months. In Palabana 29 of 58 dogs (50 %) had, according to their owners, been previously vaccinated, 18 (31 %) within the previous 12 months.

The central vaccination campaign in Mutendere

Three schools, located centrally in Mutendere were chosen as vaccination sites for the central vaccination campaign conducted on the school-free Saturday following the door-to-door campaign. A total of 378 dogs were brought for free rabies vaccination. An average of 13,1 man-minutes were used for the vaccination and collaring of a dog.

Most dogs were brought in the morning and the same proportion of males and females were brought for vaccinations. The median age was two years. Ninety-three (25%) of all the dogs presented for vaccination had been vaccinated previously; however, only 47 (12%) had been vaccinated within the last 1,5 years. It was observed that most of the dogs were brought by young boys.

Re-observation of dogs

Approximately 13 % of the total area of Mutendere was covered in the door-to-door interview and vaccination campaign in Mutendere. In the area encom-

passed by the campaign, 80 % of the dogs encountered during the re-observation were wearing collars supplied to the individuals after vaccination. In adjacent areas, only four out of 97 dogs were seen with collars, all of them very close to the vaccination zone proper. Only 17 % of all dogs were found on the street either wandering around or "resting" and 83% were observed on the premises of a house. In most cases the dogs would have been able to leave the premises as no restricting enclosures were present. For logistical reasons only one observation was conducted by car following the central vaccination campaign. Eleven out of 17 dogs (65 %) were found collared.

In Palabana the vaccination coverage of the adult and juvenile population was 86 %. Although most houses in Palabana did not have any kind of enclosure, most of the dogs re-observed were located on the premises of a house.

Dog-bites and common treatments

In both Mutendere and Palabana 5 % of the interviewed households had had at least one member in the household bitten by a dog within the previous 12 months; a total of 66 persons in Mutendere and four in Palabana. In one household in Mutendere, four persons of the same household had been bitten, possibly by the same dog. In summary, in Mutendere and Palabana 0,8 % and 0,7 % respectively of the population covered by the interviews had experienced dog bites in the past 12 months.

In most cases, some kind of treatment was undertaken after a dog bite. Fifty-six persons went to a health centre or clinic while only three visited a traditional healer. Nine persons applied some treatment at home and three did nothing. Judging from the comments given by the respondents, some persons received post-exposure treatment even though the dog had been previously vaccinated against rabies while some received only a tetanus injection after they had been bitten by a non-vaccinated dog. From informal discussions it seems that there are some common beliefs and treatments concerning dog-bites. These range from dressing the wound with herbs and tomato leaves to the application of burnt hair from the dog involved to the wound of the patient.

DISCUSSION

In Zambia, dog owners are held responsible for the actions of their dogs and are regularly taken to court, e.g. if their dog has bitten somebody. In cases in which the dog involved has not been vaccinated against rabies, expensive human post exposure vaccine has

to be purchased. However, in Zambia these vaccines are often unavailable. In general, the dog owner is required to pay a compensation and consequently, it is in the interest of the dog owners to have their dogs vaccinated against rabies and to be in the possession of a valid rabies vaccination certificate. Nevertheless, as indicated by the survey, the vaccination coverage of dogs against rabies in the study areas is unsatisfactory as only 31 % of the dogs in Palabana and 16% in Mutendere had been vaccinated during the previous 12 months. Therefore this study was aimed at obtaining information and comparing the characteristics and accessibility for parenteral vaccination of the owned segment of the dog population in a high density urban and a semi-rural area.

The urban study area, Mutendere compound, was selected for its high population density and structured setting. One thousand, one hundred and five households were interviewed in Mutendere and 11 % of these households kept dogs. Similar findings were reported by Hill (1985) in four high density suburban areas of Harare where the proportion of households with dogs varied from 9.9–17.1 %. In the semi-rural study area, Palabana, 42 % of the 85 households interviewed kept dogs.

A dog ecology study conducted in Nigeria by Oboegbulem & Nwakonobi (1989) found that 38.2% of the households in an urban area kept dogs, but only 20.4% in rural areas, suggesting that twice as many households kept dogs in the urban as compared to the rural area. Further, a higher dog:human ratio was obtained in the urban than in rural study areas (1:21 and 1:45, respectively). It was suggested that the presence of a large Muslim community, especially in the northern rural areas of Nigeria, could have accounted for this. In this study the dog:human ratio for urban Mutendere was 1:45 and 1:6.7 for rural Palabana. Brooks (1990) reported a dog:human ratio of 1:4.5 in rural and 1:16 in urban areas of Zimbabwe while Rautenbach, Boomker & De Villiers (1991) found a ratio of 1:11.1 for a rural town in Bophuthatswana.

American and European countries have reported dog to human ratios between 1:10 and 1:6. Similar ratios have been observed by Wandeler *et al.* (1988, 1993) in Buddhist and Hindu communities in South-east Asia. Although in the study areas in Zambia respondents belonged to a wide variety of tribes, no significant correlation could be observed between dog-keeping practices and tribal origin. In the urban area the economic situation of households appeared to play a major role in determining whether dogs were kept or not. In Mutendere all the houses were single storey buildings and only 9% had a fence that would restrain dogs. Houses surrounded by a wall were generally larger and better constructed than those

without. The probability of finding dogs in fenced-in households was four-times greater than in households without restraining fences. Generally, a fence and keeping dogs are two means by which properties are protected. As Mutendere is one of the low income compounds of Lusaka, the dog:human ratio calculated could be lower than in other parts of the city. The high income residential areas of Lusaka are unimportant in the design of an extensive rabies vaccination campaigns as it is very likely that many dogs have been vaccinated. Furthermore, most dogs are well protected behind fences which afford limited contact with outside dogs. In Mutendere the absence of a fence was given by several respondents as a reason for not having dogs. Over 35 % of the households without dogs claimed that they disliked keeping dogs. From informal discussions in Mutendere it appears people fear that neighbours could poison their dogs if they feel inconvenienced by them. In rural Palabana none of the houses were surrounded by a fence that could restrain dogs and boundaries between properties were often not visible. Besides guarding the property, dogs were also commonly used for hunting in the rural areas. The range of an owned dog in these settings is generally larger than in town and dogs are therefore more likely to come into contact with other dogs or wildlife (Oboegbulem & Nwakonobi 1989). Only one dog in Palabana was said to be confined during the day. In Mutendere 50 % of the dogs were never, and 32 % only irregularly, restrained.

Although only data on the owned segment of the dog population was obtained, the proportion of ownerless dogs appeared to be very small. Re-observation results indicate that the proportion of ownerless dogs is below 20 %. Wandeler *et al.* (1988) related different habitats, cultures and social strata of human populations to the carrying capacity for dog populations. Beran & Frith (1988) indicated food availability as the major limiting factor for dog population density. In the low income, high population density areas of Lusaka such as Mutendere compound, food sources available to free-roaming (whether owned or unowned) dogs appeared to be very limited. The absence of a large ownerless dog population has also been documented in other developing countries (Bogel & Joshi 1990; Fishbein, Frontini, Dobbins, Flores, Quiroz, De Jesus, Rodriguez, Woo-Ming, Garzar, Belotto, Balderas, Yenne, Linhart & Baer 1992).

The age and sex structures of the two dog populations studies are indicative of a rapid turnover of dogs. In Palabana the median age was one year and 33 % of the dogs were below three months of age. In Mutendere the median age was two years and 9 % of the dogs were puppies. There was no significant difference in the sex ratios between the two study areas. During the central vaccination campaign as many male as female dogs were presented for

immunization. In most studies there was a larger proportion of male than female dogs with the exception of Nigeria where females made up a small majority (Oboegbulem & Nwakonobi 1989).

No measures to restrict the reproduction of dogs in the two study areas are practiced and puppies are rarely killed by their owners as often occurs in other countries. In Tunisia 61% of the puppies were reported to have been killed by their owners (WHO 1988). During the interviews it was mentioned that there is a higher demand than supply for dogs especially in the urban area. The high mortality of dogs of all ages, mainly due to disease, could account for this. Diseases such as parvovirus infection and distemper are common in Zambia and should be taken into consideration especially when organizing centralized vaccination campaigns since mortalities after a rabies campaign could negatively affect the turn-up and co-operation of the public for future rabies campaigns.

Generally, the accessibility of the dogs for parenteral vaccination was good. In the rural areas several dogs were not present at the time of the interviews as they had been taken by a member of the household to the field or for hunting or had run away into the bush. During the central vaccination campaign in Mutendere no major problems in restraining the dogs were encountered. However, dogs that would have been difficult to catch or restrain might not have been brought for vaccination.

For the urban areas the central point vaccination strategy is most cost-effective especially in areas with a low dog:human ratio. Massive one or two day campaigns would better keep the motivation of vaccinators and the community up over a shorter period. Vehicles and manpower are more easily mobilized for short-term activities (Belotto 1988). For the rural areas, a village-to-village campaign would be most appropriate as the large distances to the vaccination point at crushpens and diptanks could discourage people from bringing their dogs. In larger settlements such as Palabana a door-to-door campaign could be considered as some households keep a number of dogs which may be difficult to bring to one central point.

During this study young boys generally knew the whereabouts of dogs and brought them for vaccinations. Also during the re-observation of dogs, the children were generally able to identify the dog and the household to which it belonged. The use of schools as information channels and as vaccination centres on the week-end was successfully used in Lusaka during a mass vaccination campaign following this study. Boys of school-going age should be considered as an important target group for rabies awareness and vaccination campaigns. Their availability during school holidays or on week-ends would enhance the turn-up during vaccinations.

Until recently, veterinary services in Zambia were mostly provided free of charge. Although dog owners see the need for having their dogs vaccinated, they are often not willing or able to pay for this service. Rabies, being a public health concern, the prophylactic immunization of dogs should, in our opinion, continue to be provided free of charge in Zambia especially in the rural and medium to low income urban areas. The issuing of rabies certificates is a further incentive to bringing dogs for vaccination.

Five percent of the households in Mutendere and Palabana had a member bitten by a dog within the preceding 12 months. The regulations in Zambia require a person bitten by a dog to first report to the police and veterinary services before they qualify for treatment at the hospital. A more efficient system and better cooperation between the veterinary and health authorities on rabies surveillance, dog-bite procedures and treatments, public awareness, as well as for rabies vaccinations, would enable better channelling of the already scarce resources and ensure the sustainability of rabies control programmes.

The attitude of the inhabitants towards the rabies vaccination campaign was very positive. The distance to the veterinary offices or a private clinic and costs involved had prevented people from taking their dogs for vaccination.

As described by Cifuentes (1988) rabies control consists not only of vaccinating 80% of the estimated canine population but also involves many activities such as planning, epidemiologic surveillance, providing people timely and appropriate treatment of dog-bites and creating awareness in the community.

REFERENCES

- BELOTTO, A.J. 1988. Organization of mass vaccination for dog rabies in Brazil. *Reviews of Infectious Diseases*, 10:S693-S696.
- BERAN, G.W. 1982. Ecology of dogs in the central Philippines in relation to rabies control efforts. *Comparative Immunology, Microbiology and Infectious Diseases*, 5(1):265-270.
- BERAN, G.W. & FRITH, F. 1988. Domestic animal rabies control: an overview. *Reviews of Infectious Diseases*, 10(4):S672-S677.
- BÖGEL, K. & JOSHI, D.D. 1990. Accessibility of dog populations for rabies control in Katmandu valley, Nepal. *Bulletin of the World Health Organization*, 68:611-617.
- BROOKS, R. 1990. Survey of the dog population of Zimbabwe and its level of rabies vaccination. *Veterinary Record*, 127:592-596.
- CIFUENTES, E.E. 1988. Program for the elimination of urban rabies in Latin America. *Reviews of Infectious Diseases*, 10: S689-S692.
- FISHBEIN, D.B., FRONTINI, G.M.G., DOBBINS, J.G., FLORES, C.E., QUIROZ, H.G., JESUS DE, J., RODRIGUEZ, G., WOO-MING, B., GARZAR, J., BELOTTO, A.J., BALDERAS, T.J.M., YENNE, K.M., LINHART, S.B. & BAER, G.M. 1992.

- Prevention of canine rabies in rural Mexico: an epidemiological study of vaccination campaigns. *American Journal of Tropical Medicine and Hygiene*, 47(3):317–327.
- HILL, F.W.G. 1985. A survey of the animal population in four high density suburbs in Harare. *Zimbabwe Veterinary Journal*, 16: 31–36.
- HUSSEIN, N.A., SHARMA, R.N., ANDO, R. & CHIZYUKA, H.G.B. 1984. Further review of the epidemiology of rabies in Zambia (1975–1982). *Revue Scientifique et Technique de l'Office Internationale des Epizooties*, 3(1):125–135.
- OBOEGBULEM, S.I. & NWAKONOB, I.E. 1989. Population density and ecology of dogs in Nigeria: a pilot study. *Revue Scientifique et Technique de l'Office Internationale des Epizooties*, 8(3):733–745.
- RAUTENBACH, G.H., BOOMKER, J. & DE VILLIERS, I.L. 1991. A descriptive study of the canine population in a rural town in southern Africa. *Journal of the South African Veterinary Association*, 62(4):158–162.
- WANDELER, A.I., BUDDE, A., CAPT, S., KAPPELER, A. & MATTER, H. 1988. Dog ecology and dog rabies control. *Reviews of Infectious Diseases* 10:S684–S688.
- WANDELER, A.I., MATTER, H.C., KAPPELER, A. & BUDDE, A. 1993. The ecology of dogs and canine rabies: a selective review. *Revue Scientifique et Technique de l'Office Internationale des Epizooties*, 12:51–71.
- WHO 1987. *Guidelines for rabies control*. 2nd ed. Geneva: World Health Organization.
- WHO 1988. *Report of WHO consultation on dog ecology studies related to rabies control*. 22–25 February 1988. Geneva: World Health Organization. (WHO/Rab.Res./88.25).
- WHO 1989. *World survey of rabies 25*. Geneva: World Health Organization (WHO/Rab.Res./92.203).
- WHO 1990. *Guidelines for dog population management*. Geneva: World Health Organization (WHO/Zoon./90.165).