

Mortality rates and survival analysis of owned, free-roaming dogs in a resource-limited community, Bushbuckridge, South Africa

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INTRODUCTION

- Rabies is an acute, fatal, progressive, incurable viral encephalitis affecting all warm-blooded animals, including humans. Dogs are the primary reservoir of rabies virus (RABV) in Africa for both humans and animals. Dog-transmitted rabies is estimated to kill approximately 24,000 and 31,000 people annually in Africa and Asia respectively (Knobel et al., 2005).
- Although rabies can be successfully controlled through vaccination, high rates of dog population turnover through births and deaths make the maintenance of herd immunity through vaccination challenging in populations of free-roaming dogs in low-resource settings. Understanding these demographic processes may help find solutions to create stable, vaccinated populations.

OBJECTIVE

Determine the rates and causes of mortality in owned, mostly free-roaming dogs in Hluvukani village of the Mnsi community, in Bushbuckridge Municipality, Ehlanzeni District, Mpumalanga Province.

MATERIAL AND METHODS

- A cohort of adult dogs (one year and older) was enrolled in May and June, 2014, and followed them for 12 months.
- Litters of puppies were enrolled at birth and followed for 120 days each.
- Outcomes (including death) were recorded during frequent follow-up visits, and causes of mortality were determined through owner interview ('verbal autopsy') and post-mortem examination.
- Survival curves were plotted for both adults and puppies. Kaplan-Meier log-rank test and Semi-parametric Cox regression regression were used to test for the difference of age and sex on survival.

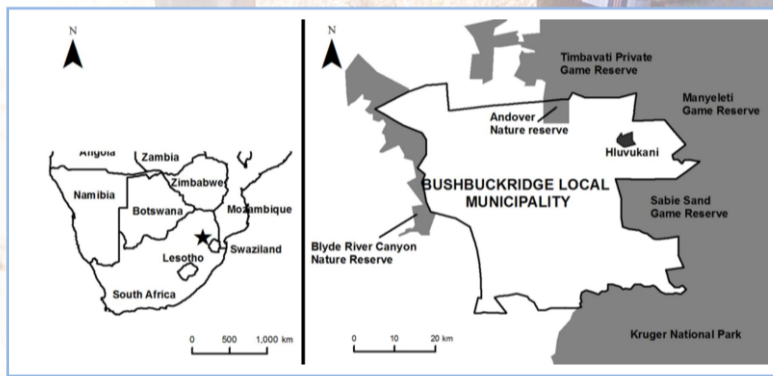


Figure 1: Location of Hluvukani village in Mpumalanga Province, South Africa

RESULTS

- Mortality rates are summarized in Table 1 and Crude monthly mortality rates are shown in Figures 2 and 3
- Female dogs had a shorter survival time (mean = 341.7 days) compared to the male dogs (mean = 355.8 days) ($p = 0.04$) (Figure 4)
- Adult dogs of age 5 years and above had shorter survival time (mean = 338.5) ($P = 0.06$) (Figure 5)
- No difference of survival between female and male was observed in puppies ($p = 0.3$)
- 135 verbal autopsy results were collated for 27 adults and 135 puppies. Deaths classification is shown in Figures 6 and 7.

Table 1: The number of dog deaths and mortality rates, stratified by sex and age in the adult dog cohort and puppies during 12 months of follow-up

	Dogs enrolled	Deaths	Mortality rate / 1000 dog-years
Total Adult	367	27	77.6
Male	203	10	50.8
Female	164	17	112.7
1-2 years	129	9	73.8
Male	71	5	73.6
Female	58	4	74.2
3-4 years	141	6	44.1
Male	74	3	41.7
Female	67	3	46.8
≥5 years	97	12	133.9
Male	58	2	35.1
Female	39	10	305.8
Total puppies	329	135	2,389.3
Male	152	50	1,811.5
Female	148	58	2,172.2
Unknown	29	27	12,857.1

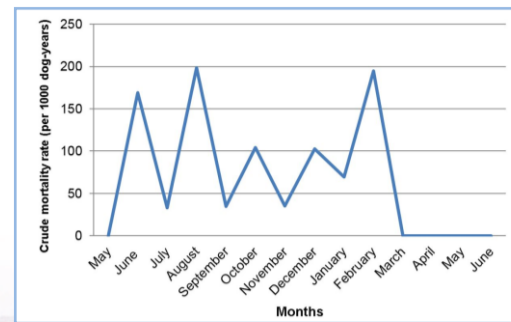


Figure 2: A line graph of adult mortality rates by month from May 2014 to June 2015

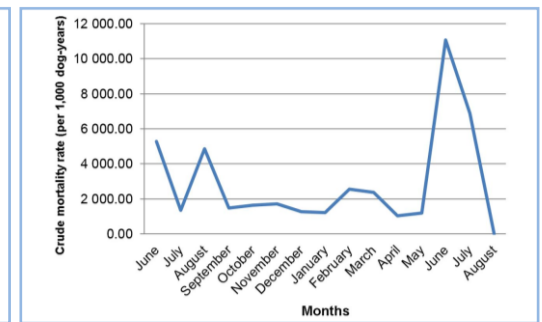


Figure 3: A line graph of puppies mortality rates by month from May 2014 to August 2015

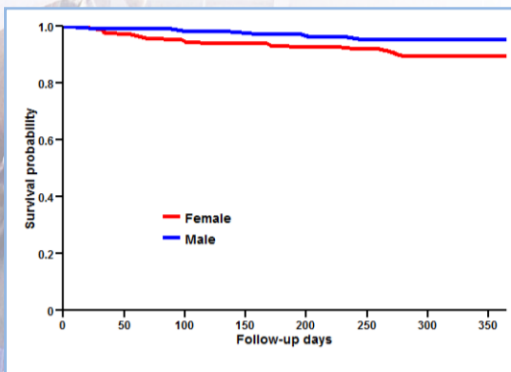


Figure 4: Survival curve for comparison between male (blue) and female (red) adult dogs ($P = 0.04$)

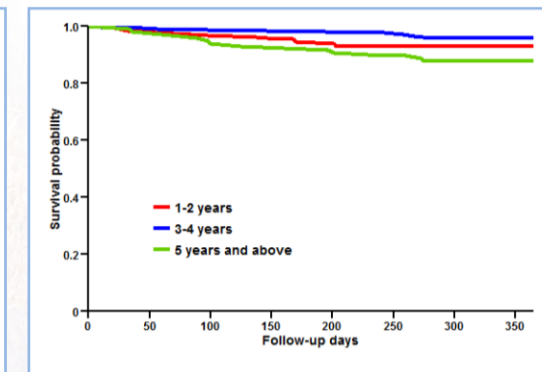


Figure 5: Survival curve for adult dogs by age categories. 1-2 years (red), 3-4 years (blue) and 5 year and above (green) ($P = 0.06$)

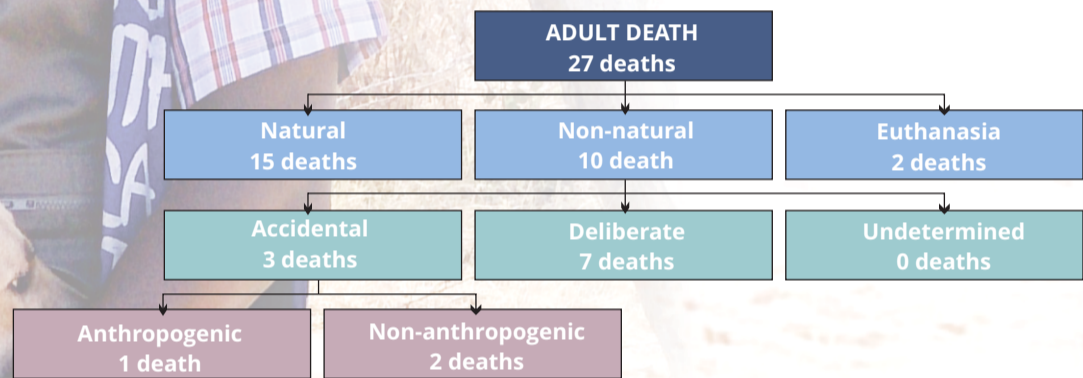


Figure 6: Flow chart showing the classification of causes of death in adults using the verbal autopsy method.

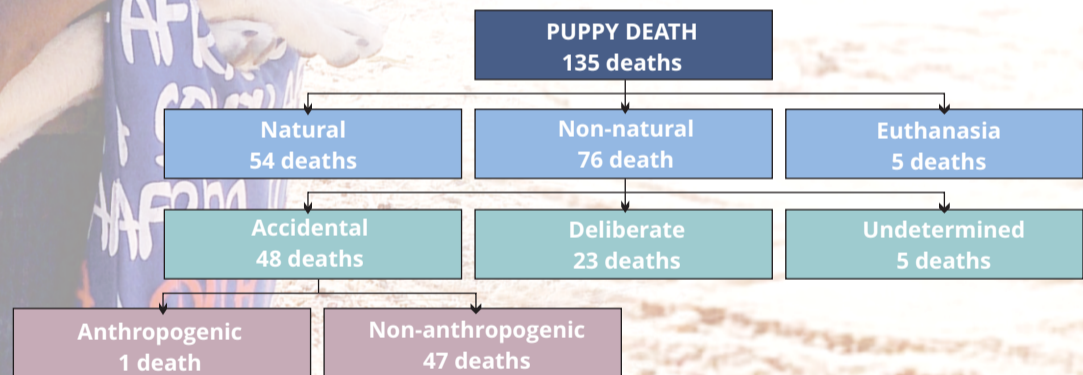


Figure 7: Flow chart showing the classification of causes of death in puppies using the verbal autopsy method.

DISCUSSION

- This study observed a low mortality rate in the adult cohort. This is higher than the rate of 39 per 1,000 dog-years seen over a five-year period in a study of insured Swedish dogs in their first year of life (Bonnett et al., 2005), but much lower than the risk of death seen in another study in Tanzania, which reported 450 deaths per 1,000 dog population (Hampson et al., 2009).
- Mortality in puppies was high with 2389.3 deaths per 1000 dog-years recorded, with a mean survival time of 60 days. Conan et al (2015) have reported the same trend in the HDSS-dog study in the same study area.
- Survival analysis between the two sexes in the adult cohort showed a significant difference, with females having significantly lower survival rates than males. The verbal autopsy indicated that most adult dogs died of natural causes and in the puppies, more deaths occurred by non-natural causes.

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