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MODELLING *ECHINOCOCCUS MULTILOCULARIS* INFECTION IN FOXES IN ZURICH

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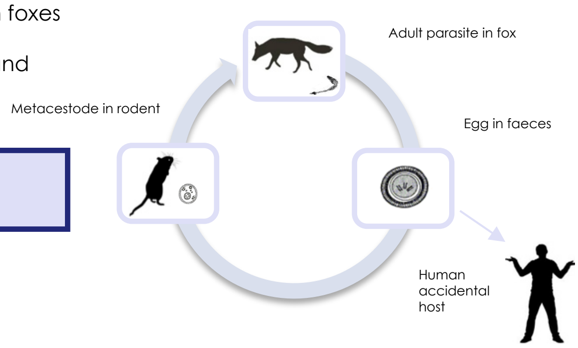
Background

Echinococcus multilocularis (EM) is a zoonotic parasite mainly transmitted between foxes and small mammals. Humans can act as aberrant hosts producing alveolar echinococcosis (AE), a fatal condition if untreated. The incidence of AE in Switzerland has recently increased coinciding with the growth of fox populations and their expansion towards the urban areas.

Figure 1. *E. multilocularis* life cycle



Has the level of urbanization an impact on EM infection in foxes in Zurich?

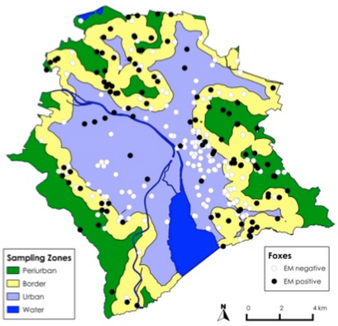


Figure 2. Location of 535 foxes, with or without *E. multilocularis* (EM), collected in the urban, border and periurban zones of the city of Zurich

Material and Methods

Data

Information on EM infection and worm counts was obtained through the necropsy of 535 red foxes (*Vulpes vulpes*) collected between January 1996 and February 2000 within the political community of Zurich (Switzerland) in the Integrated Fox Project framework. The study area was divided into three zones (periurban, border and urban). This data had previously indicated differences in prevalence between urban and rural foxes[1].

Models

Estimation of parasite mean abundance and corresponding infection pressure values (β, h) by fitting fox data to age-based transmission models assuming absence of parasite-induced host immunity[2] and by using maximum likelihood estimation (MLE) techniques. Mathematical models considering constant or varying β and h depending on zone urbanization level were compared using likelihood ratio test (LRT) and Akaike information criterion (AIC). Parasite loss rate (μ) fixed for 4 month (prevalence model) and 6 weeks (abundance model)[3].

Prevalence model

$$p(t) = \left[\frac{\beta}{(\beta+\mu)}\right][1-\exp(-\{\beta+\mu\}t)]$$

Abundance model

$$m(t) = \left[\frac{h}{\mu}\right][1-\exp(-\{\mu t\})]$$

Table 1. Transmission parameters

t	Fox age (years)
β	Infection pressure (infectious insults/year)
h	Infection pressure (parasites/year)
μ	Parasite loss rate

Results

Both prevalence and abundance models assuming spatial differences in infection pressure among urban zones presented the best fit for EM fox data (lower AIC and significant p-value for the LRT). The data showed higher infection rates for EM in foxes far from the city centre (periurban>border>urban). However, parasite burdens observed did not followed this trend (periurban>urban>border).

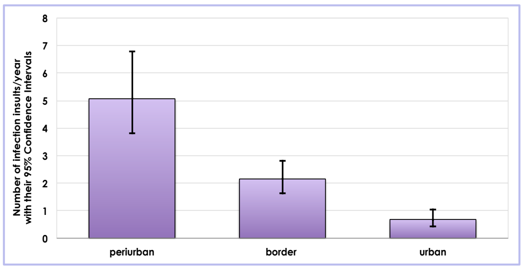


Figure 3. Prevalence model: infection pressure β

Figure 4. Urban fox

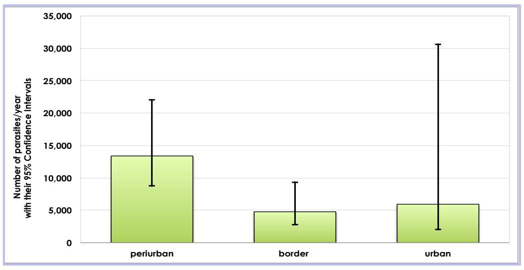


Figure 5. Abundance model: infection pressure *h*

Discussion

Even though EM prevalence in foxes is commonly higher outside the cities, the increase of fox densities nearby urban settlements together with the high parasite rates found in some individuals might result in higher environmental contamination, leading to an increasing risk in human infection. Modelling EM infection allows the better understanding of its epidemiology and potential human transmission influencing the designing of more effective control strategies, such as strategic location and frequency of medicated baits.

References

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(3)Kapel CM, Torgerson PR, Thompson RC, Deplazes P. Reproductive potential of Echinococcus multilocularis in experimentally infected foxes, dogs, raccoon dogs and cats. Int J Parasitol. 2006;36:79—86.

Acknowledgments

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