

Original Research

Lung parasites of the genus *Metastrongylus* Molin, 1861 (Nematoda: Metastrongilidae) in wild boar (*Sus scrofa barbarus*) in Middle Atlas Region of Morocco: an epidemiological study

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ABSTRACT:

Although the helminth parasites of domestic hogs are well documented worldwide, no information is available about the digestive and pulmonary helminth infections of wild boar in Morocco. The lungs of 33 wild boars (*Sus scrofa barbarus*) (19 females and 14 males) from four area of El Hajeb province (Middle Atlas) hunted officially for wildlife damage control, from October 2014 to March 2015 were examined for lung nematodes. Twenty eight out of 33 wild baors, (84.4%) were positive for three species of *Metastrongylus* and their prevalence was as follows: *Metastrongylus pudendotectus* (84.4%), *Metastrongylus confusus* (72.7%) and *Metastrongylus salmi* (51.5%). In most cases, multi-species infection was observed. Prevalence and infection intensity were found greater in juvenile females less than 1 year old than in adults and males. Prevalence and intensity of infection were higher in wild boars collected from range lands and forest than in wild boars collected in the cultivate area. Further studies are needed to understand the factors structuring Metstrongylidae communities.

Keywords:

Parasite, helminth, *metastrogylus* , *sus scrofa*, Morocco.

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INTRODUCTION

Wild boar (*Sus scrofa*) is widespread in northern Morocco and especially more frequent in the woody mountainous regions. Its distribution extends from the Rif to the Anti-Atlas Mountains, excluding pre-Saharan regions of southeast the country and the Eastern Highlands (Aulagnier and Thevenot, 1986). One of the most selective factors affecting wild boar populations and increasing the mortality of young animals is the infection by lung worms of the genus *Metastrongylus* Molin, 1861 (Nematoda: Strongylida) (Fraczak, 1974; Humbert and Henry, 1989; Houszka, 2001; Nosal *et al.*, 2010). *Metastrongylus* species causes dyspnea and progressive weight loss due to the destruction of interstitial tissues, obstruction and ultimately consolidation of lungs (Alcaide *et al.*, 2005). Until now, six *Metastrongylus* species have been described: *Metastrongylus apri* (also called *Metastrongylus elongatus*), *Metastrongylus salmi*, *Metastrongylus pudendotectus*, *Metastrongylus confusus*, *Metastrongylus*

asymmetricus and *Metastrongylus madagascariensis* (the latter are only found in pigs from Madagascar). The first three species are, by far, the most commonly reported worldwide and usually present in mixed infections. (Gassó *et al.*, 2014). Changes in the *Metastrongylus* genus distribution are expected to affect the global increase of wild boar (*Sus scrofa*) populations (Acevedo *et al.*, 2014).

The aim of this study is to identify lung nematodes present in wild boar at Morocco and to assess the prevalence and intensity of infection, to assess the effect of age and sex characteristics on the intensity of infection in wild boar population, and to evaluate the effect of external factors related to the habitat occupied by wild boars.

MATERIALS AND METHODS

The study region is located at the crossroads of the rich plain of Saïs and the foothills of the Middle Atlas, El Hajeb province (study area) which is located 30

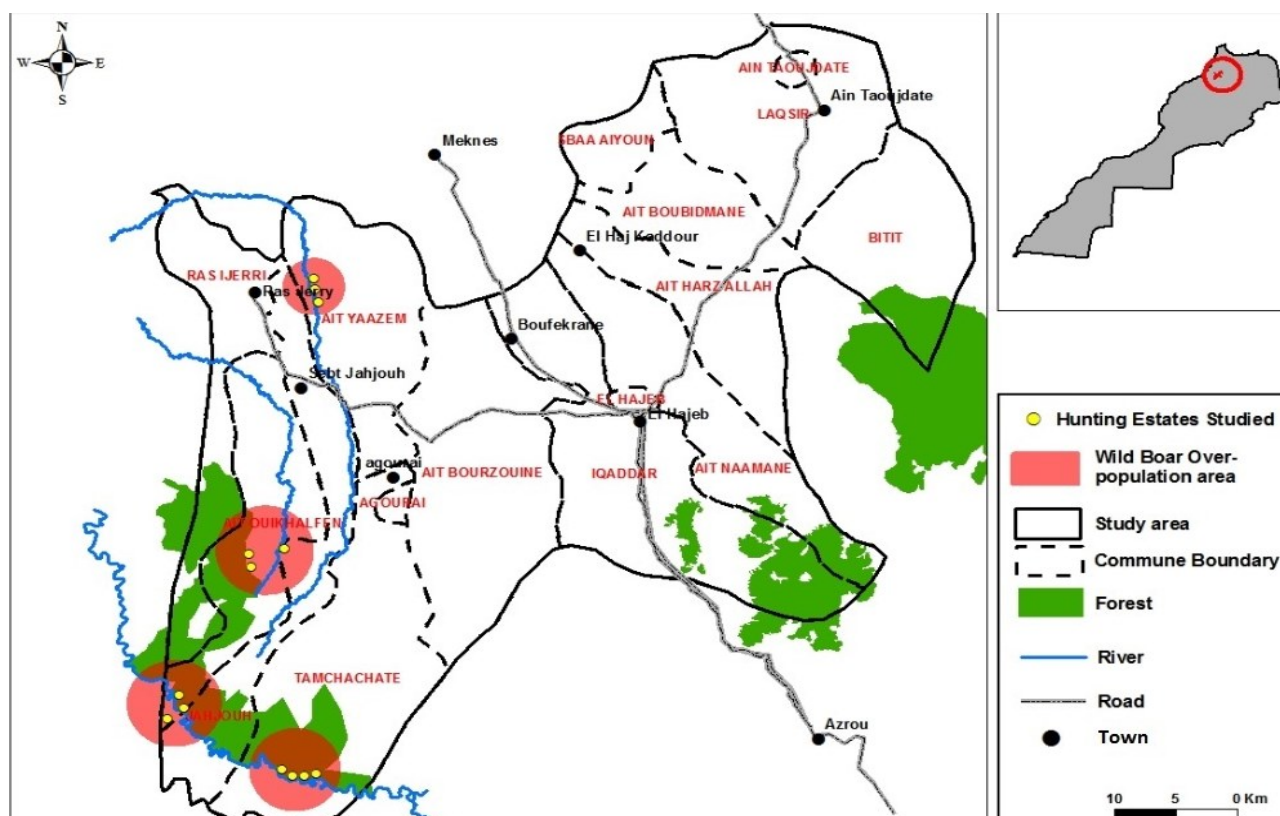


Figure 1. The study area located in El Hajeb province (Middle Atlas)

Km south of Meknes (33° 41' 45" N, 5° 22' 00"). The altitude seems to be 1000m and the climate is temperate. The winter seasons are quite cold and many days of freezing are seen but despite the altitude, summers are hot (Figure 1).

Prevalence of lung worms belonging to the genus *Metastrongylus* was surveyed on 33 wild boars (*Sus scrofa barbarus*) (19 females and 14 males) from the four areas of El Hajeb province (Middle Atlas) which were hunted officially for wildlife damage control, from october 2014 to march 2015; 13 of it were originated from the cultivated area and 20 from the rangelands and forest. The wild boars were autopsied immediately after death. The thoracic and abdominal viscera were isolated, removed, placed in plastic bags, labelled and taken to the laboratory; data recorded at sampling time included site of shooting and sex and age of wild boars. The host age was estimated according to Boitani and Mattei, (1992) and four ages were established based on tooth development: <1 year old, 1 to 2 years old, 2 to 3 years old and 3 > years old. Lungs were evaluated according to Vedrine (2006). The collected parasites were removed and placed in vials containing the fixative (10% formaline). For their identification and count, obtained worms were clarified in a Berles fluid and the species were identified following the descriptions by Hollo

(1965), Jansen (1964), Morita *et al.* (2007) and Nosal *et al.* (2010) with the aid of a microscope (10 x, 40 x, or 100 x magnification). Quantitative Parasitology 3.0 (Rózsa *et al.*, 2000) was used to detect any association between *Metastrongylus* infections and wild boar shooting site, sex and age-group.

RESULTS AND DISCUSSION

The prevalence of *Metastrongylus* sp. was 84.4%. The most frequently isolated species were *Metastrongylus pudendotectus* (84.4%), *Metastrongylus confusus* (72.7%) and *Metastrongylus salmi* (51.5%). Within the parasite community, in proportional species share, *Metastrongylus pudendotectus* (48.40%) and *Metastrongylus confusus* (39%) appeared to be the most common (Table 2). The sex ratio was the highest (1.99) for *Metastrongylus pudendotectus* and smallest (5.23) for *Metastrongylus salmi*, reaching the average of 2.54.

The infection level tend to increase with the age of wild boars, and also female hosts were more infected than male (Table 1). Prevalence and intensity of infection were higher in wild boars from the forests and range lands than those living in cultivated lands.

In Morocco there is no study registered on wild boar parasitology, so we compared our results with European studies.

Table 1. Prevalence and intensity of infection of Metastrongylidae species in relation to the age and sex of wild boars and the site of shooting

Data on wild boars	no	<i>M. pudendotectus</i>		<i>M. confusus</i>		<i>M. salmi</i>	
		P (%)	I	P(%)	I	P(%)	I(%)
Host Age							
< 1 years	17	100	13 (4 – 28)	88.2	5.4 (1 – 11)	76	6.5 (1 – 11)
1 – 2years	8	100	20.8 (3 – 47)	100	29.9 (6 – 48)	50	5.3 (1 – 10)
2 – 3 years	5	40	6 (2 – 10)	20	8 (8)	nf	nf
>3 years	3	33.3	7 (7)	nf	Nf	nf	nf
Host Sex							
Males	14	78.6	19.4 (3 – 47)	71.4	18.2 (5 – 48)	50	4.3 (7 – 11)
Females	19	89.5	11.4 (2 – 23)	73.7	10.42 (1 – 34)	52.6	9 (1 – 8)
Shooting Site							
Cultivate area	13	69.2	7 (2 – 12)	46.2	3.2 (1 – 8)	38.5	6.6 (4 – 9)
Rangelands and forest	20	95	18.1 (3 – 47)	90	17.2 (2 – 48)	60	6.1 (1 – 11)
Total	33	84.4	14.54 (2 – 47)	72.7	13.67 (1 – 48)	51.5	6.24 (1 – 11)

P – prevalence of infection (%); I – mean and range of intensity of infection (%); nf– not found

Table 2. Species and sex structure of identified Metastrongylidae specimens

Characteristics	<i>M. pedodontectus</i>	<i>M. confusus</i>	<i>M. salmi</i>	<i>M. spp</i>
No of parasites	407	328	106	841
Species share %	48.40%	39%	12.60%	100%
sex				
No. females	271	244	89	604
No. males	136	84	17	237
Sex ratio	1.99	2.9	5.23	2.54

In European countries, the infection of wild boars with lung nematodes are prevalent and affected 85% to 100% of animals (Humbert and Henry, 1989; Epe *et al.*, 1997; de-la-Muela *et al.*, 2001). The same was found on the present study; the infection in Moroccan wild boars showed to be highly widespread (prevalence 84.4%).

When comparing the prevalence obtained in different studies, it is important to consider some aspects related to the population dispersion, such as habitat and nourishment conditions (Houszka, 2001). The prevalence of infection could attain 100% in humid woodland; while in dry areas it doesn't exceeded 30%. Lambert and Henry (1989) found that intensity of lung worm's infection depended highly on frequenting the areas at high risk for acquiring the infection. In our study, wild boars collected in rangelands and forests were more infected (Table 1) and this might also be the consequence of the abundance of earthworms as the intermediate hosts of metastrongylidae in forest and rangelands.

According to some researchers, the intensity of infection of lung worms showed significant differences for the age and the sex of the wild boar. In France Humbert and Henry (1989) and Nosal *et al.* (2010) found that juveniles and male hosts were more infected by *Metastrongylus* sp. The same results was seen in Spain investigation (de-la-Muela *et al.*, 2001) and in German investigation (epe *et al.*, 1997). However, the occurrence of lungworm infection in an area is influenced by a multifactorial system, which comprises age and sex of hosts and environmental effects. Our results are partially discordant with this because we found that females are more infected than male hosts, but the intensity of

infection tended to be higher in male hosts for *Metastrongylus pudendotectus* (19.4%) and *Metastrongylus confusus* (18.2%). Under two years old, all hosts were infected by the three *Metastrongylus* species; however, the age group of 2-3 years old was not infected by *Metastrongylus salmi* and the last age group >3 years was infected just by *Metastrongylus pudendotectus* (33.3%).

In Europe, most of the studies showed that they found five species of *Metastrongylus* with different prevalence but in our study we found three species of lung worms in Moroccan wild boars. *Metastrongylus pudendotectus*, *Metastrongylus confusus* and *Metastrongylus salmi* are in the proportion of 48.40%, 39% and 12.60% respectively.

The sex ratio related both to the whole community and to each single species was always in favour of females, as previously reported by other authors. This evidence could be explained by the polygamy of nematodes (Roche and Patrzek, 1966) and by a different life expectancy between male and female worms (Poulin, 1997). The sex ratio among nematodes seemed to be related to the size of the parasite population. This is confirmed by our findings.

Metastrongylus pudendotectus was the species frequently encountered and recovered from the range lands and forest with a value of 95%. The meeting of increased prevalence in wild boars in the study was agreed with the report given by Jarvis *et al.* (2007) who opined that natural peculiarities of the area, including sufficient availability of earthworms as the intermediate hosts of Metastrongylidae that, are important factors affecting the infection of wild boars.

CONCLUSION

Studies in Morocco on wild boar population are, still fresh. Until now, no study has been registered on its parasitology, and our study showed that pulmonary pathology of Moroccan wild boar is associated with metastrongylid infection. Differences in the intensity of nematodes in young (age < 1yr) and older animals may be explained by acquired immunity in older animals as a result of repeated exposure to infection.

Further research about lung worms within the investigation area is still needed to assess their environmental concentration and to further clarify the ecology of the different species of parasites.

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