



## Helminthfauna of wild boars (*Sus scrofabarbarus*) in Morocco

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**Abstract | Objective:** the aim of this study was to determine the helminth fauna of wild boars living in forests and cultivate lands in El Hajeb province in Morocco. **Materials and Methods:** From October 2014 to March 2015 the body cavity was opened, and the digestive tract removed. The oesophagus, stomach, small and large intestine, and lungs were opened and separately examined for helminths under a microscope ( $\times 10$ ,  $\times 40$  or  $\times 100$  magnification). **Results:** Thirty three wild boars collected from two areas in the province of El Hajeb, were examined for digestive and respiratory helminth parasites. The overall prevalence of helminths fauna was 100% Helminth species and their prevalence species were *Metastrongylus Pedondotectus* (85%), followed by *Macrcantronchyrus Hirudinaceus* (82%), *Metastrongylus Confusus* (79%) and finally *Metastrongylus Salmi* (51%). Prevalence and infection intensity were greater in young animals than in older animals. There were no significant differences in prevalence between sexes groups ( $P > 0.05$ ). Prevalence of infection was higher in forest areas compared to cultivate areas. **Conclusion:** it's the first study made in Morocco about helminth fauna of wild boars, further studies are needed to investigate more the diversity of this parasite fauna.

**Keywords |** Helminths, *Sus scrofabarbarus*, Wild boar, Morocco.

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## INTRODUCTION

Wild boars (*Sus scrofa*) are distributed worldwide and found in many parts of Morocco, especially in the northern region from mountainous areas, live in condensed populations. It's an omnivores consume everything, they are considered as vertebrate pests in agricultural fields, which can cause significant damage to cultivate zone. Furthermore, they are considered as a potential source of zoonotic parasites. Although it's a reservoirs for many parasites as helminthes (Meng et al., 2009; Dodangeh et al., 2018) In the many part of the world, an increasing number of research publications in parasitic helminths fauna of wild boars *Sus scrofa* have made their appearance in the past few years. For example, in Europe (J.-F. Humbert and

Henry,

1989; De La Muela et al., 2001; Rajković-Janje et al., 2002; Fernandez-De-Merai et al., 2003; Jarvis et al., 2007; Senlik et al., 2011), in Asia (Eslami and Farsad-Hamdi 1992; Solaymani-Mohammadi et al., 2003; Sato et al., 2008) and in North America (Shender et al., 2002), In Africa (Van Wyk and Boomker 2011; Zeroual et al., 2014). In Morocco, limited data and no attention is available to disease and helminth infection of *Sus scrofa* until now. The objective of the current study is to determine the species composition of wild boar's endoparasites helminths infections in El Hajeb province, Morocco.

### STUDY AREA

The study area is at the crossway of the plain of Saïs and the hills of the middle Atlas, El Hajeb province, illustrated in Figure 1. It has an altitude of about 1000 m and it's characterized by semi-arid to sub-humid climate with an average annual rainfall of 520 mm. The minimum temperature reached was 2.8° C, while the maximum temperature reached was 38.2° C. Farming is the main source of population.

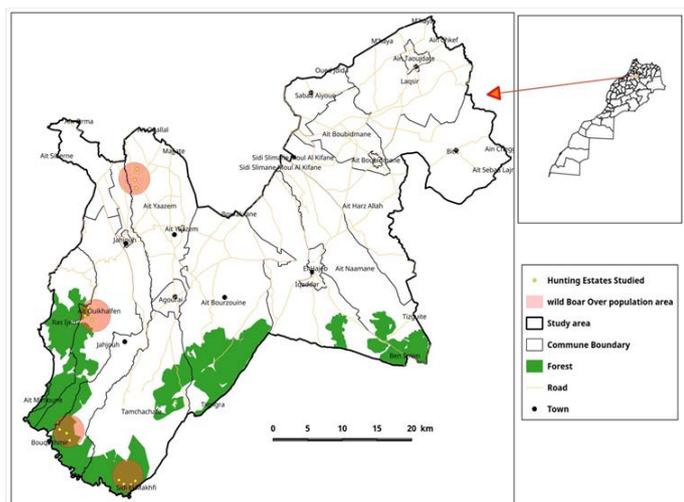


Figure 1: Mapping of the study area in the El Hajeb province

Thirty three wild boars (*Sus ScrofaBarbarus*) (19 females and 14 males) from El Hajeb province (Middle Atlas) were hunted from October 2014 to March 2015. The body cavity was opened, and the digestive tract removed. The oesophagus, stomach, small and large intestine, and lungs were opened and separately examined for helminths under a microscope ( $\times 10$ ,  $\times 40$  or  $\times 100$  magnification).

Nematodes were killed in hot saline solution, fixed in 70% ethanol, and mounted in glycerol. Worms acanthocephalans were punctured with a fine needle and subsequently stained in Mayer's acid carmine, distained in 4% hydrochloric acid in 70% ethanol, dehydrated in ascending concentrations of ethanol (24 h each), and cleared in 100% xylene then in 50% Canada balsam and 50% xylene (24 h each). Whole worms were then mounted in Canada balsam. Helminth identification was based by morphological characters according to Soulsby (1986), Gassó et al. (2016) and Sarkari et al. (2016).

The relative prevalence, mean intensity, and abundance of different helminths species were calculated by following formula as used by Margolis et al. (1982).

Data obtained were analyzed using Fisher's exact test (ver-

sion 19.0), to investigate the significance of the differences in prevalence of helminth infections according to age and sex and locations, in all the analyses, probabilities ( $P \leq 0.05$ ) were considered significant.

### RESULTS AND DISCUSSION

Out of all 33 samples (19 females and 14 males), all host were found infected with one or more helminth species. The overall infection rate was 100%. 841 lungworms were allocated to the genus *Metastrongylus* were collected; three species were morphologically identified by observing their morphological features under a microscope (Figure 2). In *Metastrongylus spp* the males reach a length of 12.5–19.5 mm, while the females measure 23.4–44.1 mm. The spicules length reach between 1.69–2.39mm. The eggs in the vagina are oval and contain fully developed larvae and grow up to a length ranging between 47.6 and 57.9  $\mu\text{m}$ . Males and females live together in nodules inside the small and midsized bronchial cavities.



Figure 2: Morphological features of the caudal end of the three *Metastrongylus* species collected. *M. salmi* (a: female, b: male); *M. confusus* (c: female, d: male); *M. pudendotectus* (e: female, f: male).

139 acanthocephalans were collected from the intestines belong to *Macracantronchyrus Hirudinaceus* species (Figure 3). Adult *Macracanthorhynchus hirudinaceus* (thorny-headed worms) are usually seen in the small intestine. They are 7 cm (males) to 24 cm (females) long, 3–9 mm thick, and slightly pink with a transversely wrinkled outer covering; superficially, they resemble ascarids, retractable proboscis used for firm attachment to the intestinal wall. Proboscis

**Table 1:** Prevalence and Mean intensity of helminth infections in wild boars in mountainous area, El Hajeb province, Morocco

Helminth species	No. of wild boars infested (%)	Total worm recovery	Mean I ±SD (range)
<i>Metastrongylus Pedondotectus</i>	28 (85)	407	12.3±10.4 (0-47)
<i>Metastrongylus Confusus</i>	26 (79)	328	9.9±13.5 (0-48)
<i>Metastrongylus Salmi</i>	17 (51)	106	3.2±3.8 (0-11)
<i>Macrcantronchyrus Hirudinaceus</i>	27 (82)	139	4.2±3.5 (0-13)

**Table 2:** Prevalence of helminth species found in wild boars in Morocco according to sex and age (Fisher’s exact test)

Helminth species	Sex		P- value	Age			P- value
	M	F		Juvenile	Sub-adult	Adult	
<i>M.Pedondotectus</i>	11 (33%)	17(52%)	P=0,175	17 (52%)	8 (24%)	8 (24%)	P=0,001
<i>M.Confusus</i>	10 (30%)	14 (42%)	P=0,272	15 (46%)	8 (24%)	1 (3 %)	P=0,002
<i>M.Salmi</i>	7 (21%)	10 (30%)	P=0,099	13 (39%)	4 (12%)	0 (0%)	P=0,425
<i>M.Hirudinaceus</i>	12 (36%)	15 (46%)	P=0,553	12 (36%)	7 (21%)	8 (24%)	P=0,940

**Table 3:** Prevalence (%) of helminth species detected in wild boars from El Hajeb Province, Morocco according to study areas. (Fisher’s exact test)

Helminth species	Site	Prevalence (%)	P- value
<i>M.pudendotectus</i>	Forest	19 (58%)	P=0,000
	Cultivate area	9 (27%)	
<i>M.confusus</i>	Forest	18 (55%)	P=0,002
	Cultivate area	6 (18%)	
<i>M.Salmi</i>	Forest	12 (36%)	P=0,425
	Cultivate area	5 (15%)	
<i>M.hirudinaceus</i>	Forest	18 (55%)	P=0,940
	Cultivate area	9(27%)	

reaches a length between 0.56 – 0.76 mm. The eggs (dark brown, embryonated, with three embryonic envelopes, and measure 90–110 × 50–65 μm).

Among the identified helminths, *Metastrongylus Pedondotectus* (85%), followed by *Macrcantronchyrus Hirudinaceus* (82 %), *Metastrongylus Confusus* (79%) and finally *Metastrongylus Salmi* (51%) are reported for the first time in Morocco (Table 1).

Pathological evaluation revealed some damages caused by the *Metastrongylus* infection is ever present in wild boars population influencing the health status of animals as loss of weight, abortion and higher mortality, especially in young animals (Alcaide et al., 2005; Marruchella et al., 2012).

*Macrcantronchyrus Hirudinaceus* has an indirect cycle using dung beetles as an intermediate host (Pavlović et al., 2010; Gassó et al., 2016;). It causes serious damage to the intestinal mucosa of their definitive host, through penetrating deep into its gut wall with its proboscis. Heavy infestations may induce catarrhal enteritis and, rarely, perforation of

the guts wall, which can result in fatal peritonitis (Diana Gassó et al., 2016).



**Figure 3:** *M. hirudinaceus*: A head of adult worm, B intestine with a heavy worm burden, C adult worm embedded in the intestine wall.

No data are available on helminth prevalence in *Sus scrofa barbarus* in Morocco, the results of this study showed a high *Metastrongylus* spp prevalence compared to result reported for boars by Solaymani-Mohammadi et al. (2003) and García-González et al. (2013) in Iran and Spain.

The prevalence of *Macracantronychus hirudinaceus* (82 %) found in our finding was consistent to that recorded respectively in Spain and in Bulgaria (Gassó et al., 2016; Panayotova-pencheva and Dakova 2018). This disparity was attributed to variability of geographical niches, gradual change in the climatic conditions, and the variation in the sampling collection procedures of each study area.

Poly-parasitism with *Metastrongylus* spp was the most frequent, and the mean intensity was a considerably greater than those of *Macracantronychus hirudinaceus*. This finding is in agreement with that of Poglayen et al. (2016). The high prevalence of infection reported in this study may reflect favorable conditions for environmental contamination and transmission of parasites in the study area.

Our study documented no difference in the prevalence from different host sexgroups ( $P \geq 0.05$ ) (Table 2) and between age groups, except for *Metastrongylus Pedodontectus* and *Metastrongylus Confusus* ( $P \leq 0.05$ ). Stojanov et al. (2018) reported that the degree of the infection was greater in female than in male wild boars, which is explained by the development of the immune response to certain parasitic species.

Furthermore, this survey studied the distribution of helminth fauna between forest and cultivate area are listed in Table 3. The difference is not significant for *M. Salmi* and *M. hirudinaceus* ( $P > 0.05$ ).

Foata et al. (2005) explained the presence of *Metastrongylus* spp by the presence of different species of earthworms, which form part of the diet of wild boars and act as intermediate hosts, the substrate type and the vegetable covering each sector.

Mobedi et al. (1971) cited that the wild boars may be infected by ingesting Scarabaeidae (dung beetles). In the present study we found that dung beetles are abundant in the hunting area.

## CONCLUSION

To our best knowledge, this is the first study in Morocco showing the helminth parasites of wild boars. Further studies are needed to investigate more the diversity of the parasite fauna of wild boars in Morocco and to determine the relationship between these parasite communities and

their host populations because wild boars might play an important role in transmitting zoonotic parasites to humans.

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## CONFLICT OF INTEREST

The authors declared that they have no potential conflict of interest with respect to the authorship and/or publication of this article.

## AUTHORS CONTRIBUTION

All authors are involved equally in the work.

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