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Intestinal helminths of golden jackals and red foxes from Tunisia

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ABSTRACT

Forty wild canids including 31 golden jackals (*Canis aureus* Linné, 1758) and 9 red foxes (*Vulpes vulpes* Linné, 1758) collected between 2008 and 2011 in the northeast, northwest and center of Tunisia were necropsied and examined for intestinal helminth parasites. All jackals and foxes were found infected with a prevalence rate of 95% for cestodes, 82.5% for nematodes and 7.5% for acanthocephalans. A total of twelve helminth species were recorded in red foxes: cestodes, *Dipylidium caninum* (55.6%), *Diplopylidium noelleri* (55.6%), *Mesocestoïdes lineatus* (55.6%), *Mesocestoïdes litteratus* (33%), *Mesocestoïdes corti* (22%); nematodes, *Ancylostoma caninum* (11%), *Uncinaria stenocephala* (44%), *Spirura rytipleurites* (11%), *Trichuris vulpis* (33%), *Pterygodermatites affinis* (67%), *Oxynema linstowi* (33%) and the acanthocephalan *Macracanthorhynchus hirudinaceus* (22%). The fifteen recovered helminth species in jackals were *Echinococcus granulosus* (9.7%), *D. caninum* (16%), *D. noelleri* (16%), *M. lineatus* (74%), *M. litteratus* (23%), *M. corti* (12.9%), *Taenia pisiformis* (3.2%), *Taenia* spp. (19%), *Toxocara canis* (16%), *Toxascaris leonina* (6.5%), *A. caninum* (9.7%), *U. stenocephala* (68%), *P. affinis* (6.5%), *O. linstowi* (3.2%) and *Macracanthorhynchus hirudinaceus* (3.2%). This is the first report on the presence of *P. affinis*, *D. noelleri* and *O. linstowi* in Tunisia. *E. granulosus* was found in young jackals, aged less than 4 years old, with a higher abundance in females (8.9 worms). *M. lineatus* presented the highest mean intensity of 231.86 and 108.8 tapeworms respectively in jackals and foxes. Canids from the northwest region had the highest prevalence (77.5%) and highest intensity (243.7) of helminth species compared to those from the northeast and central areas. *U. stenocephala* and *O. linstowi* had the highest mean intensity for nematodes in both jackals and foxes at 14.3 and 88 worms respectively.

1. Introduction

Golden jackals (*Canis aureus* Linné, 1758) and red foxes (*Vulpes vulpes* Linné, 1758) are the most widespread wild carnivores in Tunisia. They are a protected species and are only hunted after special permission from the Forest Service (Ministry of Agriculture) has been granted. Zare-Bidaki et al. (2010) suggested that these wild canids could be potential hosts for cestodes and nematodes that are infective to humans and livestock. However, little information exists on their intestinal helminthological fauna and the role of jackals and foxes in the transmission of zoonotic helminth species in Tunisia remains unknown.

Although several studies have been conducted on the prevalence of helminth infection in stray dogs from Tunisia

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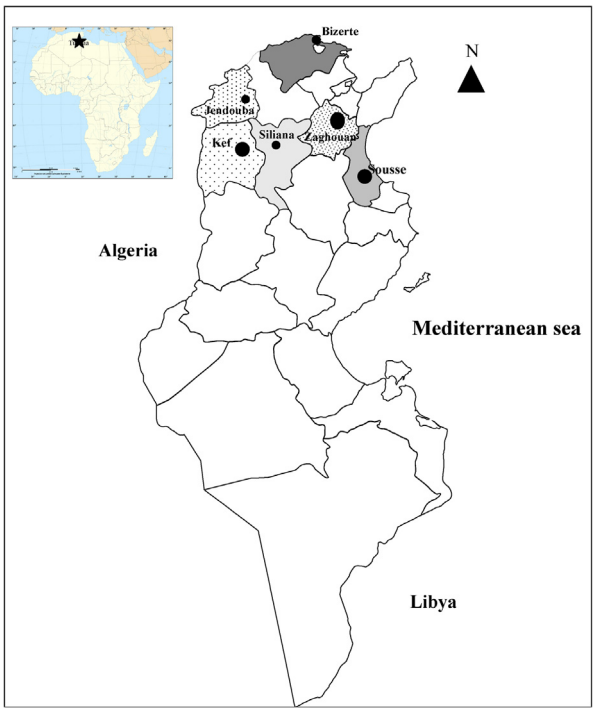

Fig. 1. A sketch map of Tunisia showing the governorate of Bizerte (Northeast), Jendouba and Kef (Northwest) and governorate of Siliana, Zaghouan and Sousse (Center) from where golden jackals and red foxes used in this study were collected.

(Lahmar et al., 2001) to the best of our knowledge only one survey has to date been published on the helminth fauna of carnivores. Using 51 fecal samples and seven necropsied wild carnivores Lahmar et al. (2009) reported the presence of *Echinococcus granulosus*, *Dipylidium caninum*, *Mesocestoïdes* sp., *Macracanthorhynchus hirudinaceus*, *Uncinaria stenocephala* and *Ancylostoma caninum* in golden jackals, red foxes, striped hyenas, genets and mongooses. The aim of the present study was to identify intestinal helminths of golden jackals and red foxes from three regions in Tunisia and to consider the role of these animals as hosts of zoonotic parasites.

2. Materials and methods

2.1. Study area

Wild canids included in this study originated from the northeast areas of Bizerte governorate (Mateur, Mabtouh, Goubollat), the northwest region of the governorate of Jendouba (Bou-Salem, Oued-Mliz, Aïn-Draham, Fernana) and Kef (Tajerouine, Kalaât-Snen) and the central region of Tunisia in the governorates of Siliana, Zaghouan and Sousse (Fig. 1). The northwest regions included in this study are dominated by mountainous and forest areas. The other two locations are low-lands with agricultural areas and limited forests. Jackals and foxes are known to roam near human habitation as well as farm locations within these areas in search of food.

2.2. Sampling

Over a 4 year period from 2008 to 2011, a total of 31 golden jackals and 9 red foxes were shot or trapped by hunters with authorized hunting licenses. Animals were transported to the Veterinary School of Sidi Thabet where the carcasses were stored at −20 °C for at least 15 days. Juveniles were distinguished from adults on the basis of deciduous teeth, tooth eruption and incompletely developed cranial sutures. On the basis of tooth wear, jackals and foxes aged between 1 and 10 years old were grouped into two main categories (≤4 and >4 years old) (Harris, 1978). Twenty-two wild canids (18 jackals and 4 foxes) were aged ≤4 years and eighteen (13 jackals and 5 foxes) were in the >4 years old group. Twenty one animals were male (18 jackals and 3 foxes) and 19 female (13 jackals and 6 foxes). Intestines of necropsied animals were stored at −80 °C for at least 7 days to inactivate infective material. The intestine of each animal was defrosted, opened longitudinally and its contents and scrapings of the mucosa were washed in isotonic saline solution (0.9% NaCl) and then carefully examined for helminths.

2.3. Parasitological procedures

At necropsy all helminths were isolated under a bright light on a tray with a black background. Species of cestodes were differentiated by the number, shape, size and arrangement of rostellar hooks and morphology of the proglottis after staining with 1% aceto-carmine solution. *Echinococcus* species were recognized by their size and the position of the genital pore (Khalil et al., 1994). Nematodes were clarified in chloral-lactophenol solution (44%) for morphological identification and enumeration (Anderson, 1992).

2.4. Data analysis

Differences in prevalence were analyzed using Chi-squared ($\chi 2$) test and Fisher's exact test (F.E.T.). Chi-squared ($\chi 2$) test was used to compare the prevalence of helminth species in the 3 studied regions, as well as the prevalence according to host age and gender. Results were considered statistically significant if the probability (p) value ≤0.05. The Student t-test was also used to determine differences in prevalence and in abundance of each helminth species according to host age and gender.

3. Results

3.1. Overall infection

All necropsied animals (31 golden jackals and 9 red foxes) were found to be infected with at least one intestinal helminth species. The most prevalent parasites were cestodes affecting 95% of animals followed by nematodes (82.5%) and acanthocephalans (7.5%). All foxes (100%) and 93.5% of jackals harbored cestodes; 78% of foxes and 83.9% of jackals were infected with nematodes while more foxes were infected with acanthocephalans (22.3%) than jackals (3.2%). The difference in the prevalence of infection with each helminth group between jackals ($\chi 2 = 63.65$; 2 d.f.;