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## Small Indian mongoose (*Herpestes auropunctatus*) in Iran: first evidence for the infection with *Spirura* sp. (Nematoda: Spiruridae)

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## PEER REVIEW

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**Comments**

This paper describes evidence of infection with nematodes in mongooses gastro-intestinal tract (actual sites were stomach), suggesting that mongooses could be one of sources of parasitic infection among wild lives. There are not enough information of this field, so I think the paper is worth publishing.

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## ABSTRACT

**Objective:** To investigate the infection with gastrointestinal helminthes in small Indian mongooses (*Herpestes auropunctatus*) and its epidemiologic aspects in Iran.

**Methods:** During June 2012 to July 2013, a total of 13 small Indian mongooses were caught using live trap boxes in an area located near Shiraz, southern of Iran. Captured animals were euthanized, eviscerated and parts of the alimentary tract were inspected. Two mongooses showed a nematode attached to the mucosa of the stomach.

**Results:** According to the main morphological characteristics, the specimens belonged to the genus *Spirura* (Blanchard 1849). This study represents the first evidences of the infection with *Spirura* sp. in *Herpestes auropunctatus* in the world.

**Conclusions:** Because the animal can invade and appear in the habitat of the other animal populations including omnivores or carnivores, it seems that mongooses in this area could have a high potential for the transmission of the infection with the spirurid nematodes to a large range of animals. Thus, besides the necessity of conducting the controlling programs, autochthonous dogs, cats and rodents should be included in more epidemiological studies in this region.

## KEYWORDS

Small Indian mongoose, *Herpestes auropunctatus*, *Spirura*, Southern Iran**1. Introduction**

The small Indian mongoose [*Herpestes auropunctatus* (*H. auropunctatus*), Hodgson 1836] (Family Herpestidae, Order Carnivora, Mammalia) is a small swift carnivore with aggressive behavior. Populations of mongooses can pose a serious threat to native wildlife, several bird species and various crops. Mongooses have proposed as a major cause for the decline of animal species<sup>[1]</sup> and therefore *H. auropunctatus* has been

listed as one of the world's 100 worst invasive species<sup>[2]</sup>.

*H. auropunctatus* has an extensive native range from Southern Asia through Northern India to Southernmost China and Indonesia<sup>[1]</sup>. Despite having a wide distribution, the parasitic infections and their zoonotic importance have not been clearly documented in this animal. Of most recorded parasites in the genus *Herpestes* (mongooses), nematodes of the order Spirurida, with a total of 10 genera and 19 species have been described. Of these 19 species, four belong to the genus *Spirura*<sup>[3]</sup>. Species of

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*Spirura* have been found in mongooses particularly in India[4,5]; however, to the authors' knowledge, no detailed document has been presented on genus *Spirura* in small Indian mongoose. This communication documents the first known case of *Spirura* sp. in *H. auro punctatus* in Iran.

## 2. Materials and methods

### 2.1. Study area

This study was undertaken during a period between June 2012 and July 2013, in an area located at about 15 km north of Shiraz (Badjgah, 29°71' N, 52°59' E), Southern Iran. According to the previous investigations, this region has accommodated small populations of small Indian mongoose (*H. auro punctatus*)[6].

### 2.2. Animals and postmortem examinations

A total of 13 mongooses were caught using live trap boxes in most available habitats. Captured animals were euthanized, eviscerated and different organs were dissected out. Each organ was inspected individually for helminth infections. Parts of the alimentary tract including the esophagus, stomach, small and large intestines were separated. The different areas were identified and sealed with ligatures to ensure that the nematodes remained in each of the different parts of the GI tract. Each of the portions was opened longitudinally and examined for the presence of nematodes. Also, the contents and washings of mucosa were rinsed using a set of sieves. After the filtration of each segment, the material retained on the sieves was collected and examined for worms under stereomicroscope at 40×. The nematode specimens were fixed in alcohol 70° and cleared in lactophenol for evaluation and measurement under optical microscope.

### 2.3. Animal ethics

All captured animals were euthanized according to the recommendations of AVMA Guidelines for the Euthanasia of Animals (2013 edition).

### 2.4. Morphological identification

The identification of the parasites was accomplished on the basis of previously reported morphological descriptions for gastrointestinal nematodes in mongooses[3,4,7,8].

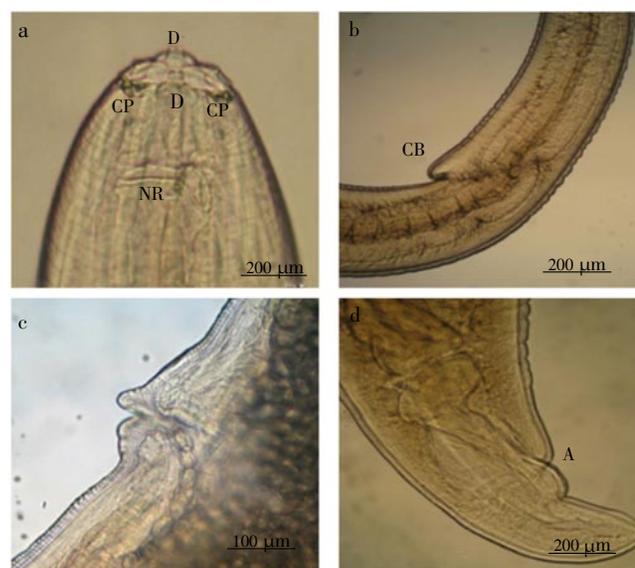
## 3. Results

Although the inspection of the alimentary canal did not

reveal the infection with helminthes, two mongooses showed a nematode attached to the mucosa of the stomach (Figure 1). The morphological examinations showed that the separated specimens were referable to the genus *Spirura* (Blanchard 1849), according to the main characteristics including shape of the body, the presence of a ventral cuticular boss and the head structure. For more details, the two nematodes were female, and had a large stout body, thick cuticle, tapering at both ends measuring 24.15 mm in length, and 770.83 μm in maximum width (as average). At the anterior head of the nematodes, two bilobal and contraposed denticles were particularly evident lateral to the median area of the mouth opening (Figure 2a).



**Figure 1.** Mucosa of the stomach from a small Indian mongoose. A species of *Spirura* was attached to the tissue.



**Figure 2.** The anterior (a & b) and posterior (c & d) parts of *Spirura* sp. (female) recovered from *H. auro punctatus*.

(a) The anterior end showing a pair of denticles (D), cephalic papillae (CP), the nerve ring (NR) and transversal striations; (b) a conspicuous cervical boss (CB) near the anterior extremity; (c) vulva opening showing oval eggs expelled from muscular ovjector; (d) the posterior end showing tail and the situation of the anal opening (A).

As a characteristic of the genus *Spirura*, a prominent cervical boss (ventral hump) was seen in specimens situated ventrally in the anterior region at about 1.42 mm from the apex (Figure 2b). The esophagus was long and filariform, comprising a short glandular anterior section and a long muscular part to the end. The vulva has a well developed sphincter without ornamentation opens in the posterior half at 16.21 mm from the anterior end (Figure 2c). Also, the uterus contained smooth, oval and non-embryonated eggs of 49.79  $\mu\text{m}$  × 32.52  $\mu\text{m}$  in size. The anal opening was in a subterminal position and the tail was short (270.83  $\mu\text{m}$  long) with conical and blunt end (Figure 2d).

#### 4. Discussion

Our study revealed the first cases of the infection with *Spirura* sp. in small Indian mongooses in the world. Of the nematodes belonging to the genus *Spirura*, four species have been reported in the submucosa and free in the lumen of esophagus and stomach of mongooses<sup>[9–12]</sup> mostly from India and Europe.

In recent decades, few investigations have introduced *Spirura* species in different kinds of mongooses; however, to the best of the authors' knowledge, no descriptive study has been presented to describe members of the genus *Spirura* in *H. auro-punctatus*. In India, Gupta<sup>[13]</sup> explained a new species of *Spirura* (*Spirura herpestis*) recovered from *Herpestes edwardsii* and Chowdhury<sup>[4]</sup> indicated the occurrence of *Spirura rytiplerites* and *Spirura herpestis* in mongoose populations. In another study, Alvarez *et al.*<sup>[3]</sup> provided a detailed morphological description on the nematode *Spirura dentata* (Mönnig 1938) in *Herpestes ichneumon* in Southern and Central Spain. Despite similarities, they explained some morphometric variations in the examined specimens compared to the previous descriptions presented by Mönnig (1938)<sup>[9]</sup>. Although we could not recover male worms and thus we did not assign the recovered specimens to a definite species of *Spirura*, it can be claimed that our morphological findings had a close accordance with main characters recorded by Alvarez *et al.*<sup>[3]</sup> for *Spirura dentata*.

The climate of the area that locates a population of mongooses trapped for the diagnosis of parasitic infections is characterized as subtropical, with average annual temperature of 16.2 °C. The area experiences non-frequent rainfalls from November to June with mean annual of 446.5 mm. In this situation, the appropriate temperature and humidity in late autumn to early spring could prepare an appropriate condition for inducing the developmental stages of larva in environment and thus continuing the

epidemiology of the parasite in a vast area.

Small Indian mongoose has an aggressive behavior frequently invading several small mammals. Therefore, the animal, as a predator, allowed predated in an area where the other animal populations are located<sup>[14]</sup>. On the other side, numbers of studies have been described and illustrated nematodes identified as *Spirura* sp. from specimens collected from the stomach of hedgehogs<sup>[15]</sup>, bats, carnivores or primates<sup>[9]</sup> and rodents<sup>[16,17]</sup>. This strongly suggests that mongooses in this area might have a role to infect the other animals particularly carnivores and rodents with the parasite and thus autochthonous dogs, cats and rodents should be included in more epidemiological studies.

Taking together, this study demonstrates the first evidences of the establishment of the infection with *Spirura* sp. in small Indian mongoose (*H. auro-punctatus*). Although a number of studies investigated some species of the genus *Spirura* in mongooses, more detailed morphological studies should be accomplished on the species of *Spirura* infecting *H. auro-punctatus*. In addition, according to the aggressive behavior of the animal as a predator, appearance of *H. auro-punctatus* in habitat of the other animals and previous reports of *Spirura* sp. from the other omnivores, carnivores or rodents, it should be considered that mongooses in this area might be a main factor to infect the other animals particularly carnivores and rodents with the parasite.

#### Conflict of interest statement

We declare that we have no conflict of interest.

#### Acknowledgements

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#### Comments

##### Background

*H. auro-punctatus*, mongooses, has a broad range of habitats from Southern Asia, Northern India to Southernmost China and Indonesia, but the parasitic infections and their zoonotic importance have not been

well documented. Nematodes, *Spirura* sp., are probably one of the most important parasites for *H. auropunctatus*, but few studies have been reported for the parasitism.

### Research frontiers

This paper describes probably the first evidences of the infection with nematodes, *Spirura* sp. in mongooses, *H. auropunctatus*, and suggests that mongooses could have a high potential for the transmission of the parasitic infection with the spirurid nematodes to other animals.

### Related reports

In India, Gupta (1986) explained a new species of *Spirura* (*Spirura herpestis*) recovered from *Herpestes edwardsii* and Chowdhury (2001) indicated the occurrence of *Spirura rytipleurites* and *Spirura herpestis* in mongoose populations. In another study, Alvarez et al. (1995) provided a detailed morphological description on the nematode *S. dentata* (Mönnig 1938) in *Herpestes ichneumon* in Southern and Central Spain.

### Innovations and breakthroughs

This paper describes probably the first evidences of the infection with nematodes, *Spirura* sp. in mongooses, *H. auropunctatus*, and suggests that mongooses could have a high potential for the transmission of the parasitic infection with the spirurid nematodes to other animals. This kind of information is basically missing.

### Applications

The present work can provide a basic information of parasite infection from mongooses to other wild lives including dogs, cats, field mice, and so on.

### Peer review

This paper describes evidence of infection with nematodes in mongooses gastro-intestinal tract (actual sites were stomach), suggesting that mongooses could be one of sources of parasitic infection among wild lives. There are not enough information of this field, so I think the paper is worth publishing.

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