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Abundance fluctuation of *Spirura rytipleurites seurati* Chabaud, 1954 (Nematoda Spiruridae) parasite of Desert Hedgehog *Hemiechinus aethiopicus* (Ehrenberg, 1833) (Insectivora Erinaceidae) in the Region of Merigha (Laghouat, Algeria)

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ABSTRACT The study has been undertaken for three consecutive years on the diet of the desert hedgehog *Hemiechinus aethiopicus* (Ehrenberg, 1833) (Insectivora Erinaceidae) in Merigha (Laghouat). It highlighted a great abundance of a parasitic nematode of the digestive tube: *Spirura rytipleurites seurati* Chabaud, 1954. The helminths are sparsely abundant in the droppings in April; while their numbers increase until June-July, then decrease drastically in August. They increase again and reach a second abundance peak in October. The droppings infestation rate varies in the same way, where these variations are interpreted in relation to the parasite cycle and to the variations of the hedgehog diet's composition.

KEY WORDS *Hemiechinus aethiopicus*; *Spirura rytipleurites*; Merigha; Algeria.

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INTRODUCTION

Like all mammals, hedgehogs host a large number of internal parasite species (Helminths) belonging mainly to the Spiruridae family (Nematoda). In Europe, *Crenosoma* Molin, 1861 and *Capillaria* Zeder, 1800 genera are the most pathogenic for hedgehogs (Reeve, 1994). They are transmitted by terrestrial gastropods. Other nematodes such as *Physaloptera dispar* Linstow, 1904 and *Gongylomena* spp. localized in the stomach and the oesophagus, respectively, are transmitted by Orthoptera or beetles (Reeve, 1994). They were reported on several European species such as *Erinaceus europaeus* Linnaeus, 1758 and *E.concolor* Martin, 1838 (Saupe & Poduschka, 1985) where the strongest infestations caused by *Physaloptera* Rudolphi, 1819 were observed on the Algerian hedgehog in Spain and North Africa (Mas-Coma & Feliu, 1984). Generally speaking, information are very limited concerning the helmintho-fauna on the Erinaceidae and on the desert hedgehog in particular. In the latter, there was only one mention of *Spirura talpae* (Gmelin, 1790) in an undetermined *Paraechinus* Trouessart, 1879 in the Hoggar (southern Algeria) (Baylis, 1930). As part of a study about the ecology of the desert hedgehog, *Hemiechinus aethiopicus* (Ehrenberg, 1833) (Kaddouri et al., 2017), we thought it would be preferable to consider the possible impact of some of its pathogens. Indeed, the

importance of these agents has too often been overlooked to understand the ecosystems functioning (Combes, 1995; Durant & Gauthier, 1996).

According to Neveu-Lemaire (1942), the Spiruridae are generally filiform nematodes, usually their mouths provided with two labia, sometimes four or six small labia. These nematodes are found during the larval stage orthoptera and beetles) (Wahl, 1967), later they complete their cycle in their final host, the hedgehog. The cycle lasts around 120 days (Chabaud, 1954). They are heteroxenous parasites of the digestive tube, the respiratory system or the orbital, nasal or oral cavities. According to Chabaud (1954), North-African hedgehogs are always spontaneously infested and this infestation is generally significant. The nematode does not seem to be pathogenic for this hedgehog. The same nematode genus (*Spirura*) was also reported from the Azores archipelago in *E. europaeus* (Casanova et al., 1996) and from Spain in the lizard *Acanthodactylus erythrurus* (Schinz, 1833) (Roca & Lluch, 1998).

MATERIAL AND METHODS

Study area

Situated in Laghouat province, Merigha commune (33°47‘59”N and 2°52‘59”East). Merigha, represents the geographical limit between the Saharan Atlas area in the northwest of the Province and the High Plateau and Saharan Plateau. The first area is characterized by altitudes ranging from 1,000 to 1,700 m with 12.5 to 25% of slope. While the second area is characterized by altitudes ranging from 700 to 1,000 m and slopes from 0 to 3%. It is made up of vast steppes of almost 2 million hectars, a large part of which has been degraded under the effect of extended droughts.

Merigha is located at 750 m of altitude and embedded at the foot of the Saharan Atlas mountains. The north side entrance of the city consists of agricultural lands, represented mainly through apricot, pear and olives orchards. Average annual precipitation is around 170 mm with peaks in autumn. The average annual temperature is 13 °C. The hottest months are between May and October with monthly maximum average above 36 °C. The coldest months are between December and February. Based on these characteristics, it is classified among the Saharan bioclimatic zone with cool winters.

Study technique

During a study of the desert hedgehog’s food strategies (Biche, 2003) we were struck by the presence of helminths in quite large numbers in the faeces samples. We systematically harvested and stored them in 5% formaldehyde, a particular vial, duly referenced, being devoted to contain a single droppings. Harvests have been carried out during the hedgehog activity period (April–October) for three years of study where the region is characterized by a particular entomological settlement.

The specific identification of nematodes was carried out in the laboratory, under a microscope using the works realized by Neveu-Lemaire (1942), Chabaud (1954) and Quentin & Krishnasamy (1975).

RESULTS

All the identified nematodes (594) belong to the species *Spirura rytipleurites seurati* Chabaud,

Figure 1. Location of Laghouat Province (Algeria).

1954. As Table 1 shows, the nematodes' collection was not important in April. It increased sharply in May to peak each year in June or July, these two months totalling more than 40% of the individuals collected. They go through a very clear off-peak in August to increase again in September and experience a second peak in October.

The variation in the droppings infestation rate follows the same pattern each year: low values in April, and starts to increase gradually until June. Thereafter, it decreases notably to reach a minimum in August. Finally, it increases again in September to reach a maximum in October. From year to year, these variations are repeated but their phenology can be shifted. However, in 2015, the peak in June was pronounced while the harvest fell quite suddenly from July. A G-test (Sokal & Rohlf, 1981) was realized on the whole table turns out to be very significant ($G = 27.91$, $p < 0.01$, 12 ddl). Heterogeneity is found, according to the partial G-tests, in the year 1997 and the months of June and July. To summarise, we noted that half of the counted nematodes were found in summer. This maximum was particularly marked in 2017 (Table 2). The parallelism with the variations in the number of nematodes (Table 2) is particularly clear.

Each year, the individuals' numbers were clearly much more abundant, where 57% and 69% of the total number of individuals were counted. Table 2 shows that the variation in the infestation rate of

	2015		2016		2017	
	n	%	n	%	n	%
April	2	1.65	11	6.32	15	5.02
May	21	17.36	24	13.79	46	15.38
June	44	36.36	31	17.82	78	26.09
July	14	11.57	47	27.01	51	17.06
August	3	2.48	7	4.02	16	5.35
September	13	10.74	12	6.90	28	9.36
October	24	19.83	42	24.14	65	21.74
Spring	23	19,01	35	20,11	61	20.40
Summer	61	50.41	85	48.85	145	48.49
Autumn	37	30.58	54	31.03	93	31.10
Total	**121**	**100**	**174**	**100**	**299**	**100**

Table 1. Temporal variations in numbers of *Spirura* found in desert hedgehog droppings during three years of study in Merigha (n: number; % percentage).

	2015			2016			2017		
	n_c	n_i	%	n_c	n_i	%	n_c	n_i	%
April	14	2	14.29	75	11	14.67	90	16	17.78
May	60	16	26.67	75	32	42.67	90	32	38.89
June	60	26	43.33	75	41	54.67	90	48	53.33
July	60	12	20.00	75	15	20.00	90	19	21.11
August	60	3	5.00	75	7	9.33	90	11	12.22
September	60	6	10.00	75	12	16.00	90	21	23.33
October	60	18	30.00	75	42	56.00	90	66	73.33
Spring	74	18	21.69	150	43	26.88	180	51	23.61
Summer	180	41	49.40	225	63	39.39	270	78	36.11
Autumn	120	24	28.92	150	54	33.75	180	87	40.28
Total	**374**	**83**	**22.19**	**525**	**160**	**30.48**	**630**	**216**	**34.29**

Table 2. Temporal variations in the rate of infestation of hedgehog droppings by *Spirura* during three years of study in Merigha. (nc: number of droppings examined; ni: number of droppings infested; %: infestation rate).

hedgehog droppings follows the variation in the numbers of collected nematodes.

DISCUSSION AND CONCLUSIONS

Coprological analyzes have highlighted the existence of a parasitic nematode of the desert hedgehog in Merigha: *Spirura rytipleurites seurati.* It is a parasite of Erinaceidae and Viverridae Carnivores, Mustelidae and canines of North Africa (Quentin et Krishnasamy, 1975). Among its final hosts we can mention the cat, the dog, the red fox, *Vulpes vulpes* Linnaeus, 1758, the zorilla, *Mellivora capensis* Schreber, 1776, and the Algerian hedgehog, *Atelerix algirus* (Lereboullet, 1842). Orthoptera and beetles species, especially those of the genera: *Blaps* Fabricius, 1775, *Pimelia* Fabricius, 1775 (Tenebrionidae), *Onthophagus* Latreille, 1802 and *Scarabaeus* Linnaeus, 1758 (Scarabaeidae) are the intermediate hosts (Neveu-Lemaire, 1942).

Fluctuations in abundance and those in parallel with the infestation rate must be related both to the parasite life cycle, in addition to fluctuations in the composition of its host's diet. The most important numbers of nematodes and infested droppings were observed practically during the summer period. The nematode reaches the adult stage in its final host, and the greatest proportions were observed at the beginning of summer where the beetles are the most hunted prey. Those nematodes found at the larval stage in the beetles (Wahl, 1967) complete their cycle (adult stage) in their definitive host which is the hedgehog. At the end of summer, the presence of nematodes drops because of the decrease of beetles' population in the animal's menu. The sectoral variations in the droppings infestation by the parasite seemed to us to be probably linked to the inter-sectoral movements of the animal.

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