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Short note

A survey on ectoparasites in captive mammals at Rabat zoo in Morocco

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ABSTRACT. Investigating the abundance and diversity of ectoparasites in captive animals is of relevance for improving their well-being and health management. Since little is known about the ectoparasites of zoo mammals in Morocco, a survey was conducted from November 2021 to May 2022 during which 16 individuals belonging to 14 mammal species were examined for arthropod parasites at the Rabat Zoological Garden. Ectoparasites were directly collected from the skin and fur and analyzed microscopically. A total of 6 ectoparasite genera were found to infest 8 mammal species with a prevalence of 57.14% (8/14). This investigation on ectoparasites in wild mammals is the first of its kind in Morocco and demonstrates the need to improve control measures of ectoparasites in the zoo.

Keywords: ectoparasites, captive mammals, wildlife, prevalence

Introduction

Wild animals are under severe threat in the wild, due to poaching, lack of natural resources and habitat fragmentation. Zoos therefore serve as conservation structures, where wildlife, especially endangered species, can reproduce and maintain a genetic pool for future introduction projects [1]. In these facilities, it is essential to maintain adequate welfare for captive animals, by providing them with suitable enclosures, studying their behavior, and controlling their diseases, including ectoparasitism [2].

Despite the myriad number of arthropod species, only few have developed parasitic behavior in which the arthropods live dependently on the surface of their hosts. Wild animals in captivity, although housed in enclosures, are not exempt from being infested by these obligate parasites that can cause a significant nuisance, either directly through blood loss, pruritus and skin lesions, or indirectly by being vectors of many pathogens (viruses, bacteria, protozoa and helminths) [3].

Surveillance and study of ectoparasites and their hosts in zoos is essential for the well-being of the housed animals. Therefore, the present study, conducted at Rabat zoo in Morocco, aimed to document the prevalence of ectoparasites in 14 mammal species, to identify them, and to correlate the findings with the taxonomic order of the studied mammals.

Materials and Methods

Study area

The study was conducted at Rabat Zoo, located in the Temara green belt (33.9553°N, 6.8943°W); it is the largest zoo in Morocco, covering an area of about 25 hectares, and housing captive animals in recreated ecosystems that simulate their natural habitats: Atlas Mountains, desert, wetlands, savannah and tropical forests.

Sample size and sampling process

Given the wild temper of zoo animals, ectoparasite screening was only applicable to individuals, under physical or chemical restraint. For ruminants, animals that could be captured without sedation were tame females. In the case of carnivores and primates, examination for arthropods

Table 1. Prevalence of ectoparasites in the five studied mammalian orders

		Artiodactyla n=4	Perissodactyla n=1	Proboscidea n=1	Carnivora n=6	Primates n=2	Overall n=14
Flea	*Ctenocephalides felis*	–	–	–	3(50)	–	3
	Echidnophaga gallinacea	–	–	–	1(16.67)	–	1
Flea positive		0	0	0	3(50)	0	3(21.43)
Lice	*Pedicinus* sp.	–	–	–	–	1(50)	1(7.14)
Lice positive		0	0	0	0	1(50)	1(7.14)
Mite	*Sarcoptes scabiei*	–	–	–	–	1(50)	1(7.14)
Mite positive		0	0	0	0	1(50)	1(7.14)
Tick	*Rhipicephalus* sp.	–	–	–	1	–	1(7.14)
	Hyalomma sp.	2(50)	–	–	–	–	2(14.28)
Tick positive		2(50)	0	0	1(16.67)	0	3(21.43)
Total		2(50)	0	0	4(66.67)	2(100)	8(57.14)

Explanations: – negative; n number of species; data are presented as number of positive species, with prevalence (%) in parentheses

without anesthesia was not feasible on most of individuals, but exceptionally on small species subject to firm physical capture. For colossal animals such as elephants, the examination of skin was not possible without chemical restraint. Ectoparasite screening took place from November 2021 to May 2022, during other medical interventions. A total of 16 skin examinations were performed on 16 individuals of 14 mammal species. Samples (except for scraping content that was examined immediately) were placed in small labelled plastic bags (4 cm×6 cm) for further examination. Gross specimens (fleas, lice and ticks) were stored in freezer overnight at –20°C pending their death.

Laboratory techniques

Areas of skin with lesions were moistened with mineral oil and then scraped using a surgical blade until capillary bleeding was visible [4]. The scrapings were placed between slide and cover glass after re-moistening with oil and immediately observed with the 10× microscope objective for the presence of mites. For all animals examined, a small tuft of their fur was plucked, immersed in mineral oil and then placed between a slide and a cover glass for the presence of ectoparasites or their eggs [5].

Macroscopic parasites, such as fleas, lice and ticks were collected directly from the skin or fur of anesthetised animals, and each type of arthropod was then submitted to an identification method depending on its size, structure and morphology [6]. Collected ticks were observed directly under stereo microscope in order to visualize structures useful for their identification. Lice themselves were observed under stereo microscope after being mounted between slide and cover glass using mineral oil.

For accurate identification, collected fleas were cleared by digestion in 10% KOH overnight, then soaked in ethanol, before being immersed in mineral oil and placed between a slide and a cover glass. The identification of the collected parasites, were according to [7–10].

Results

From 14 mammal species examined, we could detect arthropods on 8 species at a prevalence of 57.14% (8/14), with 3 (21.43%) of the animals being infested with fleas, one (7.14%) with lice, one (7.14%) with mites and 3 (21.43%) with ticks. The prevalence of ectoparasites was 50% in artiodactyls, 66.67 % in carnivores, 100% in primates and none for other orders (Tab. 1).

Artiodactyls were found positive for ticks (*Hyalomma* sp.), carnivores were infested with fleas (*Ctenocephalides felis*, *Echidnophaga gallinacea*)

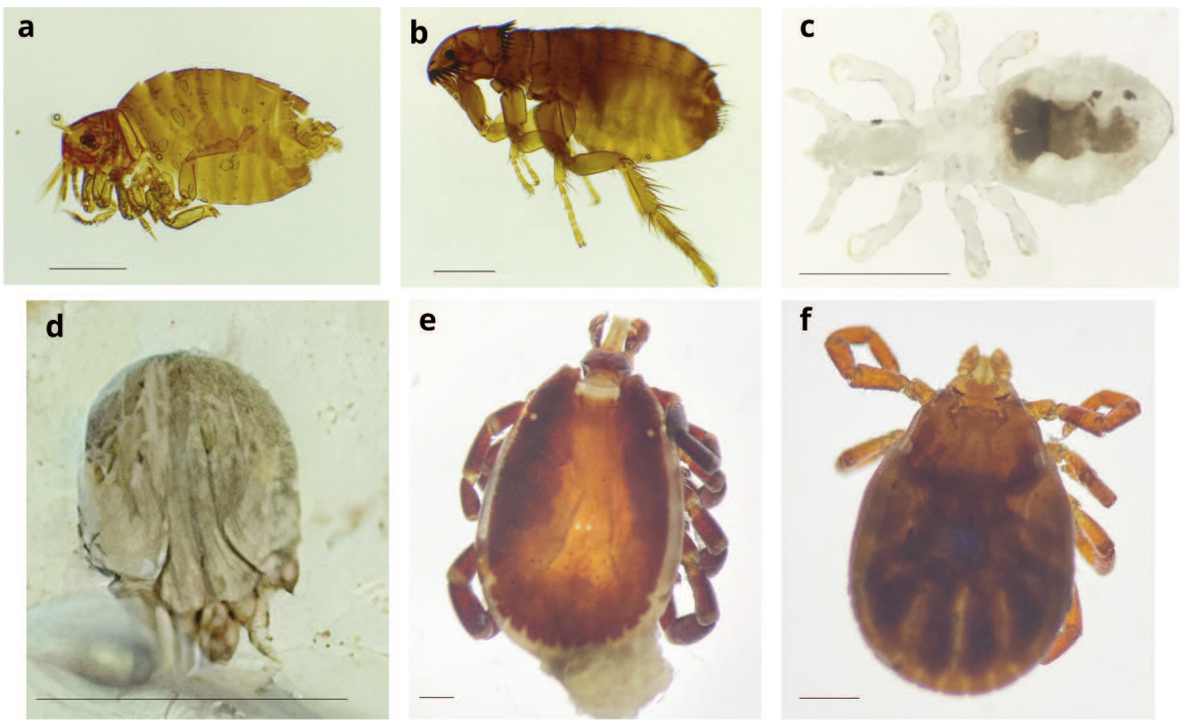

Figure 1. Different ectoparasites collected from studied mammals. (a) *Echidnophaga gallinacea* (from the fennec fox), (b) *Ctenocephalides felis* (from the fennec fox and common genet), (c) *Pedicinus* sp. (from the Barbary macaque), (d) *Sarcoptes scabiei* (from the olive baboon), (e) *Hyalomma* sp. (from the scimitar oryx and Barbary sheep), (f) *Rhipicephalus* sp. (from the red fox). Scale bar = 500 µm

Table 2. Number, type of samples and arthropod species recovered from skin of studied mammals

Order	Species	Scientific name	Chemical /Physical restraint	Type of samples	No. samples (n=16)	Arthropod species detected
Artiodactyla	scimitar oryx	*Oryx dammah*	Physical restraint	Scraping, fur	2	*Hyalomma* sp.
	Addax	*Addax nasomaculatus*	Physical restraint	Fur	1	Negative
	Common eland	*Taurotragus oryx*	Physical restraint	Fur	1	Negative
	Barbary sheep	*Ammotragus lervia*	Chemical restraint	Scraping, fur	1	*Hyalomma* sp.
Perissodactyla	Grant's zebra	*Equus quagga*	Chemical restraint	Fur	1	Negative
Proboscidea	African bush elephant	*Loxodonta africana*	Chemical restraint	Skin	1	Negative
Catnivora	caracal	*Caracal caracal*	Chemical restraint	Fur, arthropods	1	*Ctenocephalides felis*
	fennec fox	*Vulpes zerda*	Chemical restraint	Fur, arthropods	1	*C. felis*, *Echidnophaga gallinacea*
	red fox	*Vulpes vulpes*	Chemical restraint	Fur	1	*Rhipicephalus* sp.
	spotted hyena	*Crocuta crocuta*	Chemical restraint	Fur	1	Negative
	common genet	*Genetta genetta*	Chemical restraint	Fur, arthropods	1	*Ctenocephalides felis*
Primates	Barbary macaque	*Macaca sylvanus*	Chemical restraint	Fur, arthropods	1	*Pedicinus* sp.
	Olive baboon	*Papio anubis*	Chemical restraint	Fur, arthropods	1	*Sarcoptes scabiei*

while examined primates, were positive for lice (*Pedicinus* sp.) and mites (*Sarcoptes scabiei*) (Tab. 2, Fig. 1).

Discussion

With the aim of expanding knowledge of the parasitic fauna present in captive mammals, we conducted an investigation on arthropod parasites present on some African mammals of Rabat Zoo, which revealed an infestation prevalence of 57.14%, higher than the prevalence of ectoparasites concluded by the study of Tags et al. [3] in Abuja Zoological Parks from December 2017 to April 2018, which found that only 2 out of 33 animals (8.33%) were revealed to be infested. On the other hand, the survey conducted by Nelder et al. [2] from 2004 to 2007 revealed that arthropod parasites were detected on 85 out of 96 (90.6%) free-roaming animals and 12 out of 37 (32.4%) captive animals. These fluctuating results could be related to variations in the time span, number of studied animals and mammal species investigated in each study.

In this investigation, new African mammals have been described as hosts of certain ectoparasites: the fennec fox (*Vulpes zerda*) was infested with both *Ctenocephalides felis* and *Echidnophaga gallinacea*, while the Barbary sheep (*Ammotragus lervia*) and the scimitar oryx (*Oryx dammah*) were infested with *Hyalomma*. Meanwhile, the other infestations have been previously reported in wildlife: the caracal (*Caracal caracal*) and the common genet (*Genetta genetta*) were reported as hosts of *Ctenocephalides* by Horak et al. [11] and Márquez et al. [12], respectively. Sobrino et al. [13] reported *Rhipicephalus* in the red fox (*Vulpes vulpes*), Cohn et al. [14] described *Pedicinus* in the Barbary macaque (*Macaca sylvanus*) of Gibraltar and finally Mahmoud [15] identified sarcoptic mange in the olive baboons (*Papio Anubis*).

Three of arthropod genera described in this study have been reported to be vectors of numerous pathogens: *Ctenocephalides* acts as intermediate host of the tapeworm *Dipylidium caninum*, and as vector of *Bartonella* and *Rickettsia* [16]. *Rhipicephalus* transmits wide range of bacterial and parasitic agents principally *Ehrlichia*, *Mycoplasma* and *Babesia* [17]. Lastly *Hyalomma* has been reported to be a vector of Crimean-Congo hemorrhagic fever virus [18]. Therefore, studying the presence of these vectors is essential for possible future studies, which may involve a screening of vector-borne diseases in the zoo.

In conclusion, this investigation concluded that the mammals housed in Rabat Zoo were infested with ectoparasites with a prevalence of 57.14%. The arthropods collected were diverse and consisted of lice, mites, fleas and ticks. All of which can cause direct health problems to captive mammals, with the last two mentioned types being major vectors of serious pathogens. For these reasons, sanitary measures as well as treatment of the infested individuals must be firmly respected in order to ensure the welfare of the captive wildlife.

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