International Journal of Chemical and Biochemical Sciences
(ISSN 2226-9614)

Journal Home page: www.iscientific.org/Journal.html

Seasonal distribution of rodent species and their associated ectoparasites in animal farms at Sohag Governorate

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Abstract

Rodents pose a significant economic threat to animal farms due to their role in transmitting diseases, damaging infrastructure, and contaminating feed. This study investigates the seasonal distribution of rodent species and their associated ectoparasites in animal farms across Sohag Governorate. Four rodent species were identified: *Rattus rattus frugivorus, Rattus rattus alexandrinus, Rattus norvegicus,* and *Arvicanthus niloticus.* Additionally, three flea species (*Xenopsylla cheopis, Pulex irritans,* and *Leptopsylla segnis*), one lice species (*Polyplax spinulosa*), two tick species (*Hyalomma* sp. and *Haemaphysalis* sp.), and four mite species (*Ornithonyssus bacoti, Dermanyssus gallinae, Rhizoglyphus echinopus* and *Glycyphagus* sp.) were recorded. These species were surveyed during spring, summer, autumn, and winter of the 2022/2023 season, with the highest rodent density recorded in summer, followed by spring, while the lowest density was observed in winter. A positive correlation was found between rodent abundance and the prevalence of ectoparasites. *R. r. frugivorus* had the highest density, followed by *R. r. alexandrinus*, then *R. norvegicus*, and the lowest was *A. niloticus*, with percentages of 42.6%, 27.9%, 15.8%, and 13.7%, respectively. Understanding these seasonal variations is crucial for developing effective pest control strategies to mitigate the economic and health-related impacts of rodents and their ectoparasites on animal farms.

Keywords: Animal Farms - Ectoparasites - Population - Rodent - Sohag.

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1. Introduction

Rodents are among the most widely distributed mammals on Earth, often found in diverse habitats including agricultural settings where they can have significant impacts on animal farms' health and productivity. The survey of rodent species on animal farms in Egypt reveals a diverse range of rodent populations, primarily consisting of *R. r. frugivorus, R. norvegicus*, and *A. niloticus*. These species are prevalent across various regions, including Minia, Sohag, and Assiut Governorates, indicating a widespread issue for animal farms management [1,2,3,4]. Rodents can cause considerable economic damage by destroying food supplies, damaging electrical devices, and harming buildings through gnawing or by contaminating them with their waste [5]. In addition, these rodents host a wide array of ectoparasites, including fleas, lice, ticks, mites, and other arthropods, which can act as vectors for various pathogens [6,7]. Studies have surveyed rodent species and their associated ectoparasites in different regions, providing insights into the diversity and prevalence of these parasites. These ectoparasites can be vectors for various pathogens, posing potential health risks to both animals and humans [8,9]. The study of rodent species and their associated ectoparasites in agricultural environments is essential for understanding the complex ecological relationships and the possible health risks they pose to both animal farms and human populations [10,11]. These organisms play a vital role in the dissemination of diverse pathogens, which can significantly impact animal husbandry practices and public health outcomes [12,13].

Interestingly, the prevalence and diversity of ectoparasites can be influenced by various factors. Host-associated factors, such as host species, host sex and season can affect the infestation levels of fleas and mites [14,7]. Also, habitat type can influence tick infestations, with higher numbers observed in natural habitats compared to agricultural settings [7]. Rodent infestations significantly affect animal farms health and productivity, where ectoparasites associated with these rodents, such as mites and fleas, can lead to secondary infections in animals, ultimately decreasing their growth rates and milk production [4]. In urban environments, the abundance of certain ectoparasites like ticks, fleas, and chiggers may decrease with increasing urbanization [6]. When conducting a survey in animal farms, it's important to consider that rodents can serve as a "bridge" between natural areas and human settlements, potentially introducing ectoparasites and associated pathogens to animal farms [15]. Consequently, targeted research focusing on the ecology of these rodents and their ectoparasites could provide valuable insights into effective control measures and enhance overall farm biosecurity. Therefore, this study aims to identify specific rodent species that are most commonly found in animal farms and their corresponding ectoparasites, providing valuable insights for effective management strategies.

2. Materials and Methods

2.1. Study Area

This study was conducted during one season from July 2022 to June 2023 in animal farms (comprising both large and small animals) at El Monshah city, approximately 20 kilometers southwest of Sohag Governorate, covering an area of about 2 feddans. This farm is adjacent to hundreds of feddans cultivated with a variety of field crops, vegetables, and fruit trees, and it is also near several irrigation and drainage canals.

2.2. Rodent Trapping and Identification

The traps were distributed at intervals of about 10 meters between each trap, beside rodents run-ways by applying the common wire traps baited by "Luncheon" (Spring-door box traps measuring 25 x 12 x 10 cm), They were distributed three times per month between 5-6 PM and were checked the following morning between 7-8 AM to collect rodents, counted and classified into genera, species, and subspecies according to [16].

2.3. Ectoparasites collection and identification

Rodents were anesthetized in a jar containing a cotton pad soaked in chloroform. Subsequently, their fur was thoroughly combed using a brush, rodent body was thoroughly brushed, including the ears, neck, abdomen, and tail, on a white sheet of paper to collect any ectoparasites that fell off. Following this, the rodents' bodies were immersed in a solution of water mixed with liquid soap to remove any adhering ectoparasites. The solution was then filtered to separate any remaining ectoparasites. ectoparasites from each rodent were collected individually and preserved in sample tubes containing 70% ethyl alcohol for identification to the genus and species levels according to standard classification keys and taxonomic guides [17,18,19,20]. The general index of an ectoparasite on a specific rat host can be calculated as follows: general index of an ectoparasite on a specific rat host = number of ectoparasites found on rats of the same species / total number of collected rats of that species.

3. Results and Discussion

The seasonal distribution of rodent species, as presented in (Table 1 & figure 1), revealed significant variations in both abundance and diversity across seasons. A total of 190 rodents were captured during the study, encompassing four species: *R. r. frugivorous* (42.6%), *R. r. alexandrinus* (27.9%), *R. norvegicus* (15.8%), and *A. niloticus* (13.7%). The highest number of rodents was recorded in summer (n = 63, 33.2%), followed by spring (n = 53, 27.9%), autumn (n = 46, 24.2%), and winter (n = 28, 14.7%). The variability in the density of rodent species may be due to competition among the different species, which directly affects the existence of rodents. This seasonal trend also indicates that rodent populations are significantly influenced by climatic conditions, particularly temperature and food availability. Warmer seasons such as summer and spring appear to provide more favorable conditions for rodent breeding and survival, a finding consistent with studies by [21], who reported increased rodent activity and reproductive rates during warmer and wetter periods in tropical and subtropical environments. Among the captured species, *R. r. frugivorous* was the most dominant throughout all seasons, particularly in summer (34.6%) and spring (28.4%). This aligns with findings [22], who emphasized the species' high adaptability and reproductive efficiency in varied habitats, particularly those with accessible food sources and nesting sites. while *R. r. alexandrinus* showed a relatively stable presence across seasons, with its highest occurrence also in summer (32.1%) and spring (28.3%). *R. norvegicus* displayed peak abundance in summer (36.7%), This supports findings by [23], who reported a preference of these species for urban and semi-urban environments characterized by consistent food availability and moisture levels.

A. niloticus populations peaked in spring (34.6%) and summer (26.9%), indicating a preference for environments with abundant vegetation and agriculture., as confirmed by [24], who found this species to thrive in grassy habitats during the growing season. The relatively low capture rate during winter for all species may be attributed to colder temperatures, limited food availability, and reduced reproductive activity, as observed in rodent ecology studies by [25]. These findings emphasize the importance of seasonally targeted rodent control strategies, especially during peak seasons such as summer and spring when rodent activity is highest. Understanding these seasonal dynamics can aid in the development of integrated pest management programs, particularly in agricultural and urban environments.

Table 1: Seasonal distribution and relative abundance of rodent species in different seasons at animal farms in Sohag Governorate during 2022-2023 season

Species / Seasons	Rattus rattus frugivorous		Rattus rattus alexandrinus		Rattus norvegicus		Arvicanthus niloticus		Total rodents	
	No. rat	%	No. rat	%	No. rat	%	No. rat	%	No. rat	%
Summer	28	34.6	17	32.1	11	36.7	7	26.9	63	33.2
Autumn	19	23.5	12	22.6	9	30.0	6	23.1	46	24.2
Winter	11	13.6	9	16.9	4	13.3	4	15.4	28	14.7
Spring	23	28.4	15	28.3	6	20.0	9	34.6	53	27.9
Total	81	42.6	53	27.9	30	15.8	26	13.7	190	100

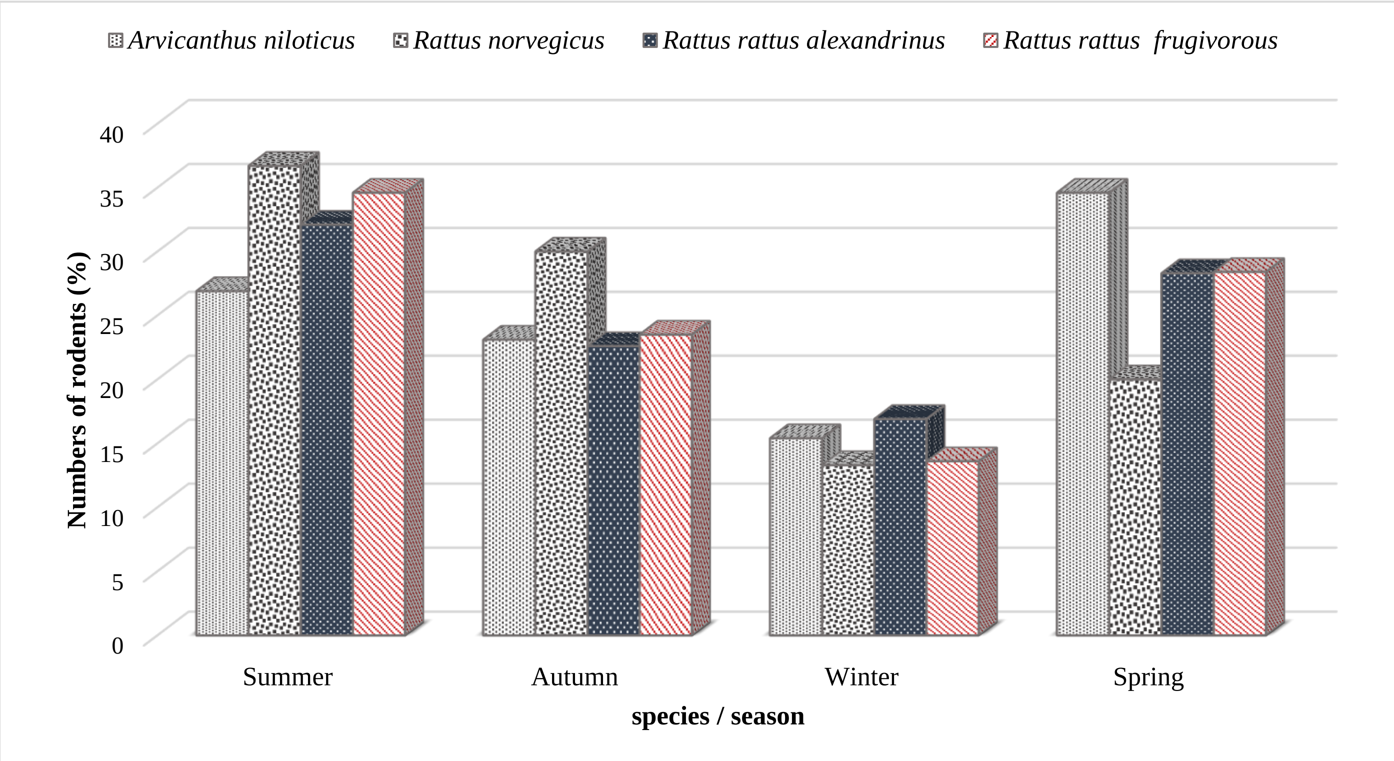

Fig. 1: Seasonal variation in population abundance of rodent species at animal farms in Sohag Governorate during season 2022-2023

Table 2: Indices of rodent ectoparasites species at the animal farms in Sohag Governorate during (2022–2023)

Rodent sp.	Number of rodents	%	Number of ectoparasites	Ectoparasites Indicus	Ectoparasite species	Number of ectoparasites	Ectoparasite /Rodents
Rattus rattus frugivorous	81	42.6	334	4.12	*Xenopsylla cheopis* (F.) *Leptopsylla segnis* (F.) *Ornithonyssus bacoti* (M.) *Rhizoglyphus echinopus* (M.) *polyplax spinulosa* (L) *Hyalomma sp.* (T.)	121 88 49 32 26 18	1.49 1.09 0.60 0.39 0.32 0.22
Rattus rattus alexandrinus	53	27.9	249	4.69	*Xenopsylla cheopis* (F.) *Ornithonyssus bacoti* (M.) *Dermanyssus gallinae* (M.) *polyplax spinulosa* (L.) *Hyalomma sp.* (T.)	102 92 22 20 13	1.92 1.73 0.42 0.38 0.24
Rattus norvegicus	30	15.8	315	10.5	*Xenopsylla cheopis* (F.) *Pulex irritans* (F.) *Ornithonyssus bacoti* (M.) *Rhizoglyphus echinopus* (M.) *Glycyphagus sp.* (M.) *polyplax spinulosa* (L.) *Haemaphysalis sp.* (T.)	126 61 44 28 17 23 16	4.20 2.03 1.47 0.93 0.57 0.77 0.53
Arvicanthus niloticus	26	13.7	78	3.0	*Xenopsylla cheopis* (F.) *Pulex irritans* (F.) *Rhizoglyphus echinopus* (M.) *polyplax spinulosa* (L.)	19 28 25 6	0.73 1.08 0.96 0.23
Total	190	100	976	5.14	———	976	5.14

F. = Fleas L. = Lice M. = Mites T. = Ticks

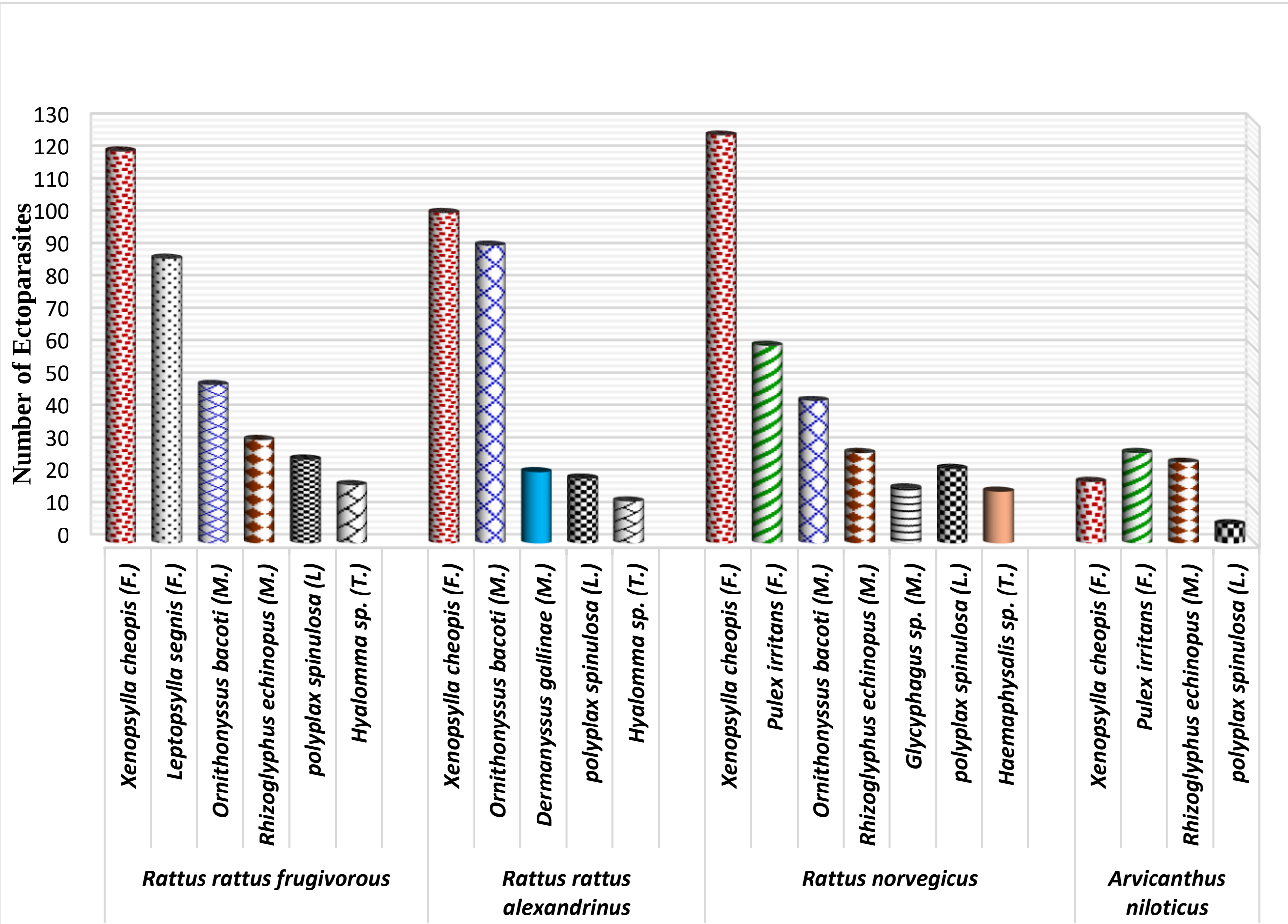

Fig. 2: Species and numbers of ectoparasite associated with each rodent species surveyed at the animal farms in Sohag Governorate during 2022–2023 season

The analysis of ectoparasitic infestation among the four rodent species captured revealed a total of 976 ectoparasites from 190 rodents (Table 2), with an overall infestation index (Ectoparasites Indicus) of 5.14 ectoparasites per rodent. The ectoparasite fauna included fleas, lice, mites, and ticks. *R. norvegicus*, although constituting only 15.8% of the total rodent population, harbored the highest number of ectoparasites (n = 315) and showed the highest infestation index (10.5 parasites/rodent). This high load may be attributed to its nesting behavior in damp, unhygienic environments, which promotes the survival and reproduction of ectoparasites. Similar observations were reported by [23], who documented increased parasite burdens in *R. norvegicus* populations in urban environments due to poor sanitation and high host density. *R. r. alexandrinus* followed with an infestation index of 4.69, hosting 249 ectoparasites. *R. r. frugivorous* recorded an index of 4.12, while *A. niloticus* showed the lowest index at 3.0, possibly due to its more open and less crowded habitat, reducing parasite transmission opportunities finding aligned with the work of [26]. Among the ectoparasites, fleas were the most prevalent (Figure 2), particularly *X. cheopis*, which is a well-known vector of plague and murine typhus. This flea species was most abundant on *R. norvegicus* (n = 126) and *R. r. frugivorous* (n = 121), reinforcing the role of these rodents in zoonotic disease transmission, according to [27]. also, Other ectoparasites included the mites: *L. segnis, O. bacoti*, and lice*: P. spinulosa*. The presence of multiple ectoparasite species per host, especially mites and lice, suggests a complex host-parasite interaction, as discussed in the work of [28], where rodent body size, grooming behavior, and social interactions significantly influenced ectoparasite diversity and burden. Interestingly, *R. norvegicus* and *A. niloticus* shared certain mite species, such as *R. echinopus*, which may indicate environmental overlap or indirect contact via shared nesting areas. The detection of *Hyalomma* and *Haemaphysalis* ticks, though infrequent, is epidemiologically important due to their role as vectors of tick-borne pathogens including Crimean-Congo hemorrhagic fever (CCHF) virus [29]. These findings underscore the ecological and public health significance of rodent ectoparasites. Rodents act as reservoirs for various ectoparasites, many of which are capable of transmitting serious zoonotic diseases. Understanding species-specific infestation patterns can guide surveillance programs and inform pest management strategies, particularly in urban and peri-urban settings.

4. Conclusions

The present study demonstrated significant seasonal fluctuations in rodent populations and their associated ectoparasites infestations across the surveyed areas. Rodent abundance and diversity peaked during the summer and spring seasons, with *R. r. frugivorous* identified as the predominant species. Among the recorded ectoparasites, *X. cheopis* exhibited the highest prevalence, particularly on *R. norvegicus*, highlighting its potential role in the transmission of zoonotic diseases. Environmental factors, particularly temperature variations and habitat characteristics, appeared to be key drivers of these seasonal patterns. Collectively, these findings underscore the critical need for seasonally tailored rodent control and ectoparasite management strategies to effectively mitigate the associated public health risks.

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