Vital Surveillances

Spatiotemporal Characteristics and Risk Zonation Analysis of Rodents and Surface-Parasitic Fleas — Inner Mongolia Autonomous Region, China, 2013–2021

Meng Shang[1,2]; Haoqiang Ji[1,2]; Ke Li[2]; Xiaoxu Wang[1,2]; Lu Wang[1,2]; Wanjun Jiang[1,2]; Ying Liang[2]; Qiyong Liu[1,2,#]

ABSTRACT

Background: Recent plague cases in Inner Mongolia prompted research on rodents and fleas. This study aimed to describe the spatiotemporal characteristics of parasitic fleas on predominant rodent species and identify plague risk areas.

Methods: We assembled monitoring data from the National Plague Surveillance System for 12 regions in Inner Mongolia from 2013 to 2021. We performed descriptive statistics using relative indices, analyzed interannual flea index trends using the Mann-Kendall test, compared spatiotemporal characteristics using the Kruskal-Wallis H test and Dunn's test, and delineated plague risk areas based on cluster analysis.

Results: In total, 134,181 rodents from 28 species were captured, with an average parasitism rate of 31.46%. A total of 143,958 fleas were collected, resulting in a total average flea index of 1.07. The primary rodent species were the Mongolian gerbil (*Meriones unguiculatus*) and Daurian ground squirrel (*Spermophilus dauricus*). The flea index showed a decreasing trend (Sen's slope=−0.06, P<0.05). *Meriones unguiculatus* had two peaks (May and October), with a delay of one to two months after peak flea parasitism. *Spermophilus dauricus* had a peak in May but two flea parasitism peaks (March and November). *Meriones unguiculatus* and *Spermophilus dauricus* flea indices varied significantly across regions (H=25.75, P<0.001; H=29.88, P<0.001). Erdos City and Xilingol League had the highest flea indices for each species, respectively. Cluster analysis divided the 12 regions into three risk zones.

Conclusions: The two predominant rodent species in Inner Mongolia have demonstrated an overall decline in flea index over time. The hotspots for flea index are primarily concentrated in Erdos and Xilingol League. Strengthening regional cooperation is crucial for tailored plague prevention and control measures.

Plague is a zoonotic disease caused by *Yersinia pestis* (*Y. pestis*), with rodents serving as reservoir hosts and fleas as vectors (*1*). Humans can contract plague through exposure to infected rodents, their fleas, or other infected humans. Historically, 3 plague pandemics have resulted in significant human casualties (*2*). Plague continues to pose a public health problem in Asia and globally (*3*–*4*).

Inner Mongolia Autonomous Region, in northern China, has the greatest longitudinal span of any provincial-level administrative division (PLAD). Annual rainfall ranges from 50 to 450 mm, and monthly average temperatures range from −28.6 to 27.3 ℃. This diverse geography supports various rodent species and their fleas, creating four natural plague foci (*5*). From 2019 to 2023, the Inner Mongolia Autonomous Region reported a cumulative total of 14 human plague cases. Therefore, systematic ecological monitoring of rodent hosts and vector fleas, along with scientific data analysis, is imperative to guide local plague prevention and control efforts.

This study summarizes rodent and ectoparasitic flea data from 12 regions in Inner Mongolia from 2013 to 2021. A spatiotemporal analysis of the flea index on predominant rodent species was conducted. Based on cluster analysis, different preventative measures were proposed for geographical areas with varying plague surveillance characteristics. This study provides a basis for the reasonable allocation of surveillance resources and effective plague prevention and control.

METHODS

Surveillance Data

Plague data from Inner Mongolia from 2013 to 2021 were obtained from the National Plague Surveillance System. Plague surveillance was performed in regions in Inner Mongolia, including parasitism rate, plague cases, host density, flea index, and rate of positive fleas.

Surveillance was conducted primarily in accordance with the National Plague Surveillance Program (*6*) in both plague-focus and non-focus counties using fixed and mobile sites for comprehensive animal plague monitoring. Stratified sampling, representing 0.5% of habitats, was implemented. Captured rodents were individually bagged, anesthetized with ether, and examined for fleas using a fine brush in a white porcelain basin. The collected fleas were classified and counted.

The flea infestation rate was calculated as the proportion of rodents with fleas relative to the total number of rodents inspected. The host-flea index was calculated by dividing the total number of fleas by the number of rodents inspected.

Fleas were tested for *Y. pestis* using the stomach pumping method. Fleas from the same host, species, and location were grouped (10–20 fleas per group) for testing. All procedures adhered to the Determination for natural plague foci and plague epizootics (*7*).

Statistical Analysis

Flea indices for different rodent species were analyzed using the Kruskal-Wallis *H* test and Dunn's test for multiple group comparisons. The Mann-Kendall test was used to analyze trends in the interannual variations of the flea indices. Hierarchical cluster analysis was used to cluster the surveillance data and determine plague risk zones. Statistical analyses were performed in R 4.2.2 (R Foundation for Statistical Computing, Vienna, Austria). A two-tailed test was conducted with a significance level of 0.05.

RESULTS

Rodent Species and Flea Parasitism Status

From 2013 to 2021, 134,181 rodents belonging to 28 species were captured in Inner Mongolia. Of these, 42,216 were infested with fleas, yielding an average flea parasitism rate of 31.46%. A total of 143,958 fleas were captured, with a flea index of 1.07. The predominant rodent species were the Mongolian gerbil *Meriones unguiculatus* (*M. unguiculatus*) (44.04%) and the Daurian ground squirrel *Spermophilus dauricus* (*S. dauricus*) (36.65%). *S. dauricus* exhibited a higher flea parasitism rate (38.82%) and flea index (1.49) than *M. unguiculatus* (24.80% and 0.64, respectively). Rodent population and parasitic status are shown in Table 1.

Temporal Distribution Analysis

The Mann-Kendall test indicated that the total flea index, as well as the flea indices of *M. unguiculatus*, *S. dauricus*, and other rodents, all exhibited a declining trend (Supplementary Table S1, available at https://weekly.chinacdc.cn/). However, the decreasing trend in the flea index for the two predominant rodent species was not significant (P>0.05). The distribution of flea indices among *M. unguiculatus*, *S. dauricus*, and other rodents was not identical (H=20.38, P<0.001) according to the Kruskal-Wallis H test (Supplementary Table S2, available at https://weekly.chinacdc.cn/). Pairwise comparisons using Dunn's test revealed a statistically significant difference in flea indices between *M. unguiculatus* and *S. dauricus* (P<0.001). Figure 1 shows that *M. unguiculatus* was recorded throughout the year. Two seasonal peaks occurred, in May and October, while the peak flea index occurred in August. *S. dauricus* was detected only from March to December, with the highest numbers in May, and the flea index was higher in March and November. Other rodents showed higher numbers in May and September, with peak flea indices occurring in March and October.

Spatial Distribution Analysis

Geographically, *M. unguiculatus* was the predominant species in Wuhai, Ulanqab, Hohhot, Bayan Nur, Baotou, and Erdos, while *S. dauricus* was more common in Chifeng, Tongliao, Hulun Buir, and Hinggan League. Both rodent species had a high proportion in the Xilingol League, but *Meriones meridianus* was more frequent in the Alxa League, as shown in Figure 2.

Overall, Erdos and Wuhai had relatively high cumulative flea indices in *M. unguiculatus* from 2013 to 2021, as shown in Supplementary Table S3 (available at https://weekly.chinacdc.cn/). The Kruskal-Wallis H test indicated a significant overall difference among the regions (H=25.75, P<0.001). Pairwise comparisons revealed that the flea index in Erdos was significantly higher than that in Hohhot (P<0.01), and the flea index in Wuhai was significantly higher than that in Hohhot and Ulanqab (P<0.05), as shown in Supplementary Table S4 (available at https://weekly.chinacdc.cn/).

Similarly, Xilingol League consistently exhibited a

TABLE 1. The rodent host and flea vector surveillance in Inner Mongolia, 2013–2021.

Species	Number of rodents	Number of rodents parasitized by fleas	Flea parasitism rate (%)	Number of fleas	Flea index
Meriones unguiculatus	59,096	14,656	24.80	37,937	0.64
Spermophilus dauricus	49,171	19,089	38.82	73,176	1.49
Microtus brandti	8,374	2,748	32.82	6,930	0.83
Meriones meridianus	3,835	1,091	28.45	3,190	0.83
Cricetulus barabensis	3,423	826	24.13	1,644	0.48
Allactaga sibirica	2,905	1,091	37.56	3,685	1.27
Rhombomys opimus	1,566	1,165	74.39	12,890	8.23
Phodopus roborovskii	1,287	131	10.18	275	0.21
Dipus sagitta	1,023	308	30.11	762	0.74
Phodopus sungarus	640	220	34.38	616	0.96
Cricetulus migratorius	543	249	45.86	819	1.51
Spermophilus erythrogenys	497	209	42.05	664	1.34
Lagurus luteus	456	147	32.24	492	1.08
Mus musculus	357	9	2.52	37	0.10
Cricetulus eversmanni	309	100	32.36	365	1.18
Marmota bobak	193	33	17.10	76	0.39
Spermophilus alaschanicus	125	76	60.80	137	1.10
Euchoreues uaso	117	16	13.68	84	0.72
Rattus norvegicus	116	9	7.76	15	0.13
Marmota himalayana	74	33	44.59	132	1.78
Myospalax aspalax	25	1	4.00	11	0.44
Eutamias sibiricus	18	0	0.00	0	0.00
Scirtopoda telum	17	6	35.29	18	1.06
Microtus gregalis	7	1	14.29	0	0.00
Cardiocranius paradoxu	3	0	0.00	0	0.00
Apodemus agrarius	2	0	0.00	0	0.00
Cricetulus triton	1	1	100.00	2	2.00
Salpingotus kozlovi	1	1	100.00	1	1.00
Total	134,181	42,216	31.46	143,958	1.07

high flea index from 2013 to 2021, as shown in Supplementary Table S5 (available at https://weekly.chinacdc.cn/). The Kruskal-Wallis H test revealed a significant overall difference among the regions (H=29.88, P<0.001). Pairwise comparisons indicated that the flea index in Xilingol League was significantly higher than that in Chifeng, Hinggan League, Hulun Buir, and Tongliao (P<0.01), as shown in Supplementary Table S6 (available at https://weekly.chinacdc.cn/). For the specific spatial distribution year by year, see attached Supplementary Tables S3 and S5 (available at https://weekly.chinacdc.cn/).

Classification of Risk Zones

After clustering based on parasitism rate, flea index, flea positive detection rate, number of plague cases, and host density, 12 regions were grouped into 3 categories (Figure 3). Xilingol League and Bayan Nur clustered together, characterized by high flea indices (1.57 and 1.52) and the highest number of plague cases (3 and 2). The 3 regions represented by Erdos were characterized by a high parasitism rate and high rodent density. The remaining 7 regions were characterized by low flea parasitism rates and minimal positive flea detection rates.

DISCUSSION

In the current study, 28 rodent species were detected. The predominant species, *M. unguiculatus*

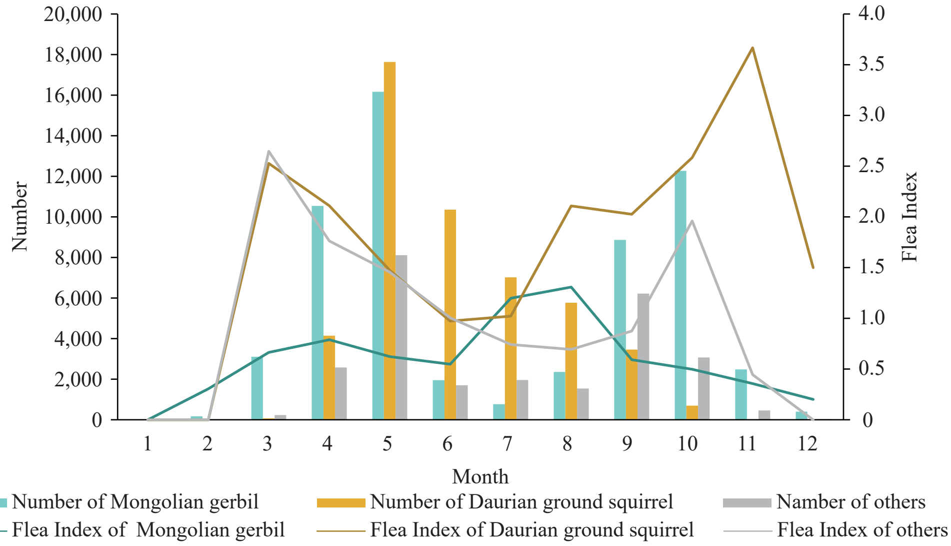

FIGURE 1. Seasonal trends in rodent numbers and flea indices in Inner Mongolia, 2013–2021.

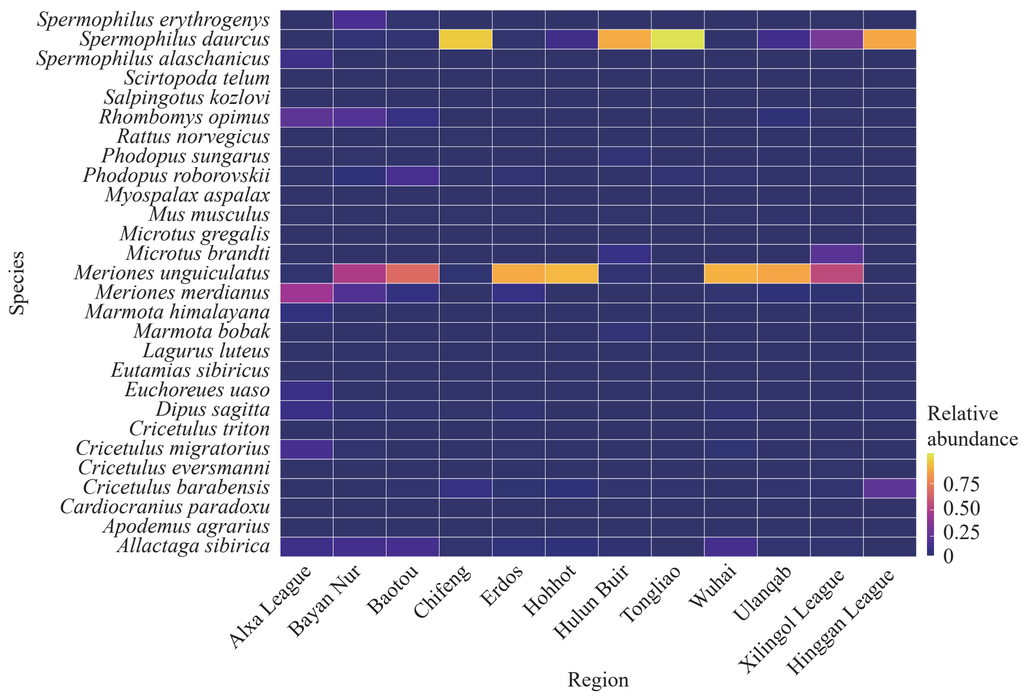

FIGURE 2. Rodent species composition in regions of Inner Mongolia during 2013–2021.

and *S. dauricus*, accounted for approximately 80%. Despite the greater number of *M. unguiculatus*, *S. dauricus* exhibited a higher flea parasitism rate and flea index. This difference may be partly attributable to the larger size of *S. dauricus* compared to *M. unguiculatus*. Furthermore, *M. unguiculatus*, being social rodents with close intergroup social connections (*8*), likely reduce flea parasitism through mutual grooming.

This study analyzed the temporal trends of flea indices on annual and monthly scales. Annually, the observed decline in flea indices for the two predominant rodent species may be attributed to the implementation of ongoing and effective human flea control measures. For instance, following a series of rodent and flea control interventions in plague-endemic areas, such as the significant reduction in rodent density and flea parasitism rates observed in the *M. unguiculatus* habitats in 2021, there has been a notable decrease in these indicators (*9*). The Monthly lag effect of the rodent population and flea index may

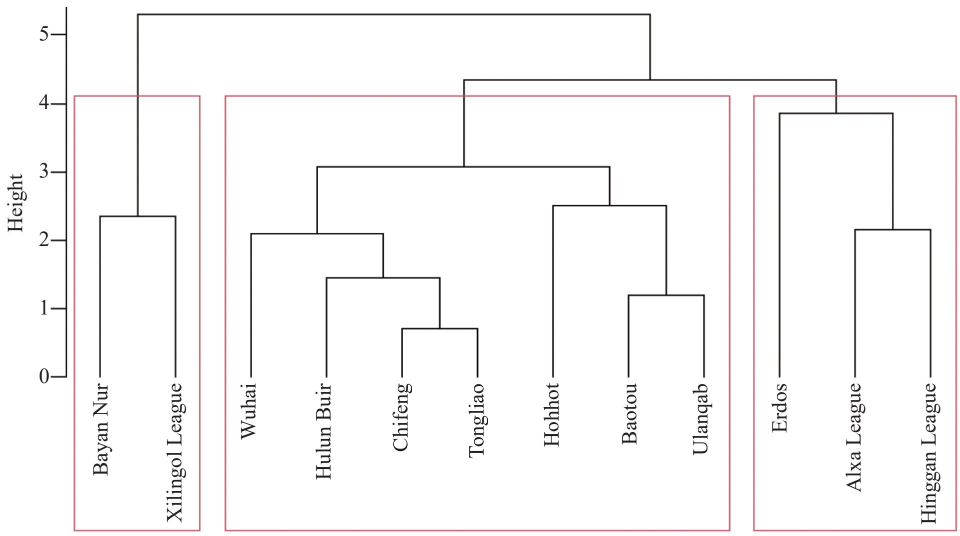

FIGURE 3. Cluster analysis of host-vector-pathogen-plague cases in the Inner Mongolia, 2013–2021.

play a positive role in local plague prevention and control. Therefore, some studies used the flea index to predict outbreaks of rodent plague (*10*). However, due to the flea index's instability, the predictive accuracy of many studies was limited (*11*). This suggests that flea and rodent control efforts in early spring and late summer may yield better results in preventing and controlling plague in Inner Mongolia.

This study showed that *S. dauricus* predominated in the eastern Xilingol League, while *M. unguiculatus* was more common in the west (excluding the Alxa League). However, both species coexisted in the Xilingol League. The total flea index of *M. unguiculatus* in Erdos and Wuhai was higher than in other cities in previous years. This is likely because most counties in these 2 cities are located within natural plague foci for *M. unguiculatus* and have a long history as plague-endemic areas (*12*). This plague focus is primarily centered on the Ordos and Ulanqab Plateaus, and recent research has confirmed the continued plague prevalence in the Ordos Plateau region (*13*). This study showed that the geographic center of the flea index changed dynamically. In 2015, Bayan Nur had the highest flea index, while in 2018, the Xilingol League had the highest. Both areas have reported human plague cases in recent years (*14*). This further underscores the close relationship between the flea index and plague occurrence.

Over the past several years, the flea index of *S. dauricus* in the Xilingol League has remained consistently high, surpassing neighboring areas and peaking at 4.69 in 2014. Quantitative analysis indicates that sustaining the spread of *Y. pestis* requires more than 3.9 *Xenopsylla cheopis* fleas per host rodent (*15*). Previous studies have divided this natural plague focus into the Songliao Plain and Chaha Hills regions (*16*). Consequently, a high flea index may signal a risk of a local plague outbreak. If rodent plague occurs, the elevated flea index increases the likelihood of spreading to other animal populations and spillover into humans, raising the risk of a plague epidemic. Additionally, this study showed that the flea indices for both *M. unguiculatus* and *S. dauricus* in this area have been consistently high, posing significant challenges for local plague prevention and control.

Regional collaboration is effective for controlling epidemics. This study classified the 12 regions of Inner Mongolia into three zones based on cluster analysis and plague surveillance indicators, recommending customized control measures for each zone. Zone A (many plague cases and a high flea index) should enhance grassroots capacity for detecting human plague, preventing its spread to larger cities, and implementing effective flea eradication measures. Zone B (high parasitic flea rate and rodent density) should intensify rodent density management and implement rodent eradication measures. Zone C (low parasitic flea and positive rates) should regularize monitoring efforts and health education to maintain a low plague risk.

Our study had some limitations. Due to variations in rodent and flea control measures across PLADs, and fluctuations in plague incidence among rodents, flea-to-host ratios may shift, introducing bias. Given the limited availability of relevant plague monitoring indicators, the resulting risk zone classifications may not be as comprehensive as desired.

In this study, we described the rodent and flea species composition in the Inner Mongolia Autonomous Region from 2013 to 2021. We primarily identified the flea parasitism status of two predominant rodent species, analyzed the spatiotemporal characteristics of the host and ectoparasite, and delineated plague risk areas based on plague surveillance data. These studies can provide valuable information for developing strategies and policies to prevent and control plague outbreaks in the Inner Mongolia Autonomous Region.

Conflicts of interest: No conflicts of interest were reported.

Acknowledgements: We gratefully acknowledge the Chinese Center for Disease Control and Prevention for their legitimate software support and administrative assistance. We also thank Steven Su for his invaluable assistance in the language review of this manuscript.

Funding: National Natural Science Foundation of China (No. 32090023).

doi: 10.46234/ccdcw2024.241

Corresponding author: Qiyong Liu, liuqiyong@icdc.cn.

[1] Department of Vector Control, School of Public Health, Cheeloo College of Medicine, Shandong University, Jinan City, Shandong Province, China; [2] National Key Laboratory of Intelligent Tracking and Forecasting for Infectious Diseases, National Institute for Communicable Disease Control and Prevention, Chinese Center for Disease Control and Prevention, Beijing, China.

Submitted: February 01, 2024; Accepted: September 26, 2024

REFERENCES

1. Barbieri R, Signoli M, Chevé D, Costedoat C, Tzortzis S, Aboudharam G, et al. *Yersinia pestis*: the natural history of plague. Clin Microbiol Rev 2020;34(1):e00044 – 19. https://doi.org/10.1128/cmr.00044-19.
2. Bennasar-Figueras A. The natural and clinical history of plague: from the ancient pandemics to modern insights. Microorganisms 2024;12(1):146. https://doi.org/10.3390/microorganisms12010146.
3. Randremanana R, Andrianaivoarimanana V, Nikolay B, Ramasindrazana B, Paireau J, Ten Bosch QA, et al. Epidemiological characteristics of an urban plague epidemic in Madagascar, August-November, 2017: an outbreak report. Lancet Infect Dis 2019;19(5):537 – 45. https://doi.org/10.1016/s1473-3099(18)30730-8.
4. Stenseth NC, Bramanti B, Büntgen U, Fell HG, Cohn S, Sebbane F, et al. Reply to Alfani: Reconstructing past plague ecology to understand human history. Proc Natl Acad Sci USA 2023;120(11):e2300760120. https://doi.org/10.1073/pnas.2300760120.
5. Fang XY, Liu QY, Xu L, Zhou DS, Cui YJ, Dong XQ, et al. Ecological-geographic landscapes of natural plague foci in China VIII Typing of natural plague foci. Chin J Epidemiol 2013;34(1):91 – 7. https://doi.org/10.3760/cma.j.issn.0254-6450.2013.01.022.
6. The Minister of Health of the People’s Republic of China. National plague surveillance program. Beijing: The Minister of Health of the People’s Republic of China. 2005. https://www.chinacdc.cn/jkyj/crb2/jl/sy/jswj_sy/202409/t20240906_297008.html. (In Chinese).
7. National Health Commission of the People's Republic of China. GB 16883-2022 Determination for natural plague foci and plague epizootics. Beijing: Standards Press of China, 2022. https://std.samr.gov.cn/gb/search/gbDetailed?id=DAB6B92C0760FC96E05397BE0A0A5F84. [2022-3-15]. (In Chinese).
8. Deng K, Liu W, Wang DH. Inter-group associations in Mongolian gerbils: Quantitative evidence from social network analysis. Integr Zool 2017;12(6):446 – 56. https://doi.org/10.1111/1749-4877.12272.
9. Han B, Liu HJ, Zhang DY, Feng YL, Li JY, Zhang ZB. An epidemiological survey of animal plague in *Meriones unguiculatus* plague foci of Inner Mongolia Autonomous Region, China, 2018-2022. Chin J Vector Biol Control 2023;34(5):697-702. http://html.rhhz.net/ZGMJSWXJKZXZZ/1698396686978-1500344141.htm. (In Chinese).
10. Mou WT, Li B, Wang XJ, Wang Y, Liao PH, Zhang XB, et al. Flea index predicts plague epizootics among great gerbils (*Rhombomys opimus*) in the Junggar Basin China plague focus. Parasit Vectors 2022;15(1):214. https://doi.org/10.1186/s13071-022-05330-7.
11. Eisen RJ, Atiku LA, Mpanga JT, Enscore RE, Acayo S, Kaggwa J, et al. An evaluation of the flea index as a predictor of plague epizootics in the west Nile region of Uganda. J Med Entomol 2020;57(3):893 – 900. https://doi.org/10.1093/jme/tjz248.
12. Zhang F, Li H, Tian J, Ren ZN, Li ZC. Analysis on the current situation of plague natural foci of *Meriones unguiculatus* in the Inner Mongolian Plateau. Chin J Control Endem Dis 2020;35(3):220-2. https://d.wanfangdata.com.cn/periodical/zgdfbfzzz202003009. (In Chinese).
13. Liu BX, Zhang DY, Chen YH, He ZK, Liu J, Lyu DY, et al. Epidemiological characteristics of plague in the *Meriones unguiculatus* plague focus - Inner Mongolia autonomous region, China, 1950-2019. China CDC Wkly 2020;2(49):935 – 45. https://doi.org/10.46234/ccdcw2020.256.
14. Zhou HJ, Guo SB. Two cases of imported pneumonic plague in Beijing, China. Medicine (Baltimore) 2020;99(44):e22932. https://doi.org/10.1097/md.0000000000022932.
15. Eisen RJ, Wilder AP, Bearden SW, Montenieri JA and Gage KL. Early-phase transmission of *Yersinia pestis* by unblocked *Xenopsylla cheopis* (Siphonaptera: Pulicidae) is as efficient as transmission by blocked fleas. J Med Entomol 2007;44(4):678 – 82. https://doi.org/10.1093/jmedent/44.4.678.
16. Zhang F, Ju C. Temporal and spatial distribution of plague focus and animal plague of *Spermophilus dauricus*. Chin J Control Endem Dis 2019;34(6):642-3. https://kns.cnki.net/KCMS/detail/detail.aspx?dbcode=CJFD&filename=DYBF201906013. (In Chinese).

SUPPLEMENTARY MATERIAL

SUPPLEMENTARY TABLE S1. Mann-Kendall test of flea indices across different rodent species.

Flea Index	Sen's slope (95% *CI*)	Z	*P*
All rodents	−0.06 (−0.12, −0.01)	−2.19	0.03
Meriones unguiculatus	−0.02 (−0.08, 0.02)	−0.94	0.35
Spermophilus dauricus	−0.05 (−0.14, 0.03)	−1.15	0.25
Others	−0.03 (−0.11, 0.02)	−1.77	0.08

Abbreviation: *CI*=confidence intervals.

SUPPLEMENTARY TABLE S2. Comparative analysis of flea indices among rodent species

Col Mean−Row Mean	*Meriones unguiculatus*	*Spermophilus dauricus*	Others
Spermophilus dauricus	−4.51*	−	
Others	−2.17*	2.35*	−

* $P<0.05$.

SUPPLEMENTARY TABLE S3. Flea indices for the Mongolian gerbil in its dominant areas in Inner Mongolia, 2013–2021.

Year	Hohhot	Ulanqab	Baotou	Bayan Nur	Xilingol League	Wuhai	Erdos
2013	0.3	0.29	0.33	1.31	0.74	1.68	10.07
2014	0.29	0.29	0.42	1.32	0.90	1.35	2.17
2015	0.38	0.74	0.59	1.31	0.80	1.20	0.82
2016	0.38	0.44	0.47	1.04	0.74	0.94	1.43
2017	0.34	0.33	0.33	0.12	0.60	1.32	0.28
2018	0.34	0.61	0.79	0.70	0.95	0.68	0.53
2019	0.35	0.24	0.20	0.38	0.55	0.96	0.62
2020	0.2	0.41	0.57	1.13	0.87	0.28	1.10
2021	0.26	0.32	0.54	0.26	0.52	0.75	0.64
Total	0.30	0.38	0.43	0.70	0.73	0.80	0.94

SUPPLEMENTARY TABLE S4. Comparative analysis of flea index among different regions for Mongolian Gerbil.

Col Mean−Row Mean	Baotou	Bayan Nur	Erdos	Hohhot	Ulanqab	Wuhai
Bayan Nur	−1.55	−	−	−	−	−
Erdos	−2.20	−0.65	−	−	−	−
Hohhot	1.18	2.73	3.38*	−	−	−
Ulanqab	0.56	2.11	2.76	−0.62	−	−
Wuhai	−2.55	−1.00	−0.35	−3.73*	−3.11*	−
Xilingol League	−1.78	−0.23	0.42	−2.96	−2.34	0.77

Note: *P*-value adjustment method: False Discovery Rate.
* $P<0.05$.

SUPPLEMENTARY TABLE S5. Flea indices for the daurian ground squirrel in its dominant areas in Inner Mongolia, 2013−2021.

Year	Tongliao	Chifeng	Hinggan League	Hulun Buir	Xilingol League
2013	0.75	0.92	0.81	1.68	3.03
2014	0.68	0.98	0.89	1.38	4.69
2015	0.64	0.79	0.95	1.70	3.41
2016	0.65	0.96	0.85	0.62	3.79
2017	0.57	1.02	0.70	0.42	3.06
2018	0.51	0.72	0.93	0.91	3.39
2019	0.46	0.75	1.19	0.54	2.47
2020	0.43	0.78	1.74	0.80	3.12
2021	0.38	0.55	1.03	1.45	2.97
Total	0.55	0.83	1.02	1.07	3.29

SUPPLEMENTARY TABLE S6. Comparative analysis of flea index among different regions for Daurian Ground Squirrel.

Col Mean−Row Mean	Chifeng	Hinggan League	Hulun Buir	Tongliao
Hinggan League	−0.80	–	–	–
Hulun Buir	−0.24	0.56	–	–
Tongliao	1.98	2.77	2.22	–
Xilingol League	−3.40*	−2.60*	−3.16*	−5.38*

Note: *P*-value adjustment method: Bonferroni.
* P<0.05.