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Spread of rabies in the Kyiv Oblast during 2020-2022

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Abstract. In Ukraine, there is a prominent level of rabies circulation among domestic and wild carnivores. Consequently, the epizootic situation of rabies in Ukraine requires studying the spread of this infection using modern surveillance tools, which allow for territorial assessment and identification of risk zones during analysis. The purpose of this research was to describe the spatial characteristics of the rabies epizootic in the Kyiv Oblast during 2020-2022, focusing on both wild and domestic animals. Official reporting data were analysed to examine the total number of samples of pathological material (brain tissue) collected from various animal species with suspected rabies.

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Positive samples were georeferenced and visualized using software to form clusters of rabies cases based on years and types of animals, creating point layers and density mapping of cases. The analysis revealed that in the Kyiv Oblast, 1788 samples of pathological brain material from animals with suspected rabies were examined, of which 237 were positive. The largest number of samples belonged to wild animals (primarily foxes), acting as a reservoir of the infection. The proportion of wild animals accounted for 64.4% of the total examined, but the number of positive samples varied between 1.7% and 5.5%. Compared to domestic animals (cats and dogs), this figure reached up to 30.0% of the total number of samples examined. Other animal species accounted for 3.2% of positive cases among the total examined. Thus, the highest morbidity rate was observed in domestic animals, representing 72.1% of the total identified positive cases. The highest density of rabies cases in the Kyiv Oblast was observed in the southwest and centre. Persistent clusters of rabies cases were in the Bila Tserkva district and the western outskirts of Kyiv. In the western part of Kyiv, the cluster was formed by cases in wild animals, cats, and dogs. In the Bila Tserkva district, the cluster was formed by cases in wild animals, cats, dogs, and cattle. The highest density of rabies cases in wild animals was registered on the western outskirts of Kyiv

Keywords: *Rabies virus*; epizootic; mapping; density of cases; clusters of cases

INTRODUCTION

Rabies remains a relevant zoonotic disease in Ukraine, and despite all efforts to combat this infection, according to official veterinary reports, the number of registered cases during the first quarter of 2023 has nearly doubled both among wild and domestic animals. Therefore, epidemiological monitoring, surveillance, and analysis of the rabies situation are indispensable. The use of geographic information systems (GIS) provides the opportunity for comprehensive analysis of the epidemiological situation, allowing for the prediction of new cases, planning, and monitoring the situation.

GIS technologies are applied in various fields of rabiology, including routine monitoring, assessment of vaccination effectiveness, detection of new risk zones for animal infection with subsequent rabies spread, and identification of species-related patterns (Fayisa, 2020). In Ukraine, the initial steps have already been taken to determine the geographic coordinates for each rabies case, and a database using GIS technology has been established. Some authors have presented their research results on an endemic rabies outbreak in the Chernihiv Oblast using GIS (Polupan *et al.*, 2017). Subsequently, data related to rabies cases in the Volyn, Lviv, and Zakarpattia Oblasts were also presented. According to some authors, a national rabies database will become an effective information resource in the future (Makovska *et al.*, 2020). Determining spatial trends and identifying rabies clusters can be useful in making decisions about the effective allocation of efforts for disease control, facilitating the development and planning of anti-epizootic measures for rabies (Golik *et al.*, 2018).

Rabies stays a significant zoonotic disease affecting animals and poses a threat to human populations worldwide (Fisher *et al.*, 2018; Banyard *et al.*, 2018). Many researchers report that over 59,000 people die from rabies annually globally (Riccardi *et al.*, 2021; Scott *et al.*, 2021). According to Ukrainian scientists (Polupan *et al.*, 2019; Makovska *et al.*, 2020), approximately 1,600 cases of rabies among animals and sporadic cases in humans are recorded annually in Ukraine during the 21st century.

According to foreign authors (Vos *et al.*, 2017; Maki *et al.*, 2017; Mähl *et al.*, 2021), the most effective method of rabies control, targeting the infection reservoir directly, is oral vaccination of wild carnivores, primarily red foxes. These measures have been implemented in our country for a long time, but in an incomplete scope (Kornienko *et al.*, 2019), which is why Ukraine remains endemic for rabies (Flis, 2021). Another essential aspect of rabies control, especially its urban manifestation, is the vaccination of domestic carnivores (Moore *et al.*, 2018; Raynor *et al.*, 2021; Natesan *et al.*, 2023). The current "Instructions on measures to combat animal rabies" (1994) stipulate that all dogs and, in areas of permanent epizootic risk, at the discretion of state veterinary medicine authorities, cats must undergo mandatory rabies vaccination.

Unlike other countries in Eastern and Central Europe, Ukraine experiences a high circulation of rabies among domestic carnivores (including stray dogs and cats) and the same number of cases among wild carnivores (Mazur *et al.*, 2017). In Ukraine, over 3 million dogs and approximately 2 million cats are vaccinated annually, along with more than 300,000 heads of livestock. It should be noted that most companion animals are vaccinated against rabies by private veterinarians.

Issues with conducting parenteral antirabic vaccination of domestic animals include the lack of a proper identification system for animals, the absence of developed "Rules for keeping dogs, cats, and predatory animals in populated areas of Ukraine," and a program for humane control of stray animal population and vaccination. Therefore, despite significant efforts in combating rabies among dogs and cats, these animal species continue to be prominently featured in veterinary reports on infectious diseases and contribute to the tense epizootic situation of rabies in Ukraine (Golik *et al.*, 2018).

The ongoing direct and indirect impact on the rabies epizootic situation in Ukraine calls for studying the spread of this infection using modern surveillance tools, particularly programs and resources based on geographic information systems, which are promising for analysing the rabies epizootic situation (Bouslama *et al.*, 2020; Müller *et al.*, 2020).

Based on the above, the authors set out to describe the species and spatial characteristics of the rabies epizootic in the Kyiv Oblast over three years (2020-2022) among wild and domestic animals.

MATERIALS AND METHODS

The research material consisted of official data on rabies cases among animals in the Kyiv Oblast for the years 2020-2022. According to quarterly and annual reports from the Central State Testing Laboratory of the State Service of Ukraine for Food Safety and Consumer Protection in the Kyiv Oblast and the city of Kyiv (n.d.), as well as aggregated data from the State Scientific Research Institute of Laboratory Diagnostics and Veterinary Sanitary Expertise (2023), a total of 1788 samples of brain tissue suspected of rabies were examined from various animal species (foxes 64.42%, cats 18.51%, dogs 13.87%, raccoon dogs 0.17%, cattle 0.27%, roe deer 0.06%, hares 0.17%, weasels 0.22%, badgers 0.17%, hedgehogs 0.17%, squirrels 0.4%, muskrats 0.17%, martens 0.27%, moles 0.1%, hamsters 0.1%, rats 0.5%, mice 0.27%, bats 0.06%).

Positive samples underwent descriptive statistical analysis and were categorized by years, animal species, and administrative locations with geospatial coordinates (longitude and latitude). The overall dynamics of rabies cases, dynamics by animal species, and characteristics of the rabies epizootic process were also determined, including density and localization. In other words, the analysis focused only on confirmed positive cases of rabies without control of negative samples. The standard graphical components of MS Office were used for statistical processing.

The mapping of rabies cases was performed using QGIS 3.28.7 software (DIVA, 2023). To determine and visualize clusters of rabies cases by years and animal species, the Heatmap tool was utilized. This tool converts (smooths) the point layer into a continuous surface of point density. The main parameter of this tool is the search radius, which controls the degree of smoothing. The optimal search radius was calculated using the methodology proposed by Murray (2010). The pixel size of the output raster was set to 100 m. Other parameters were kept as default. The vector layers of Ukrainian administrative boundaries for regions and districts were obtained from the geoBoundaries: Global Database of Political Administrative Boundaries; QGIS provides information on borders of Ukrainian regions as of (2023).

RESULTS AND DISCUSSION

During the period from 2020 to 2022, a total of 1788 samples of pathological material (brain tissue) suspected of rabies were examined in the Kyiv Oblast, of which 237 (13.3%) tested positive. In 2020, there were 114 positive cases (19.0%) of rabies detected, 66 cases (6.7%) in 2021, and 57 cases (27.9%) in 2022 (Fig. 1).

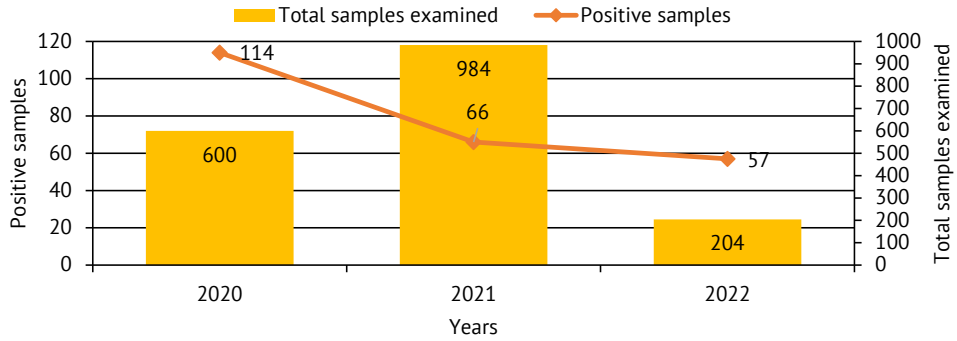

Figure 1. *Total number of examinations and detected positive cases of rabies (2020-2022)*
Source: *compiled based on the veterinary reports of the State Scientific Research Institute of Laboratory Diagnostics and Veterinary Sanitary Expertise (2023)*

It should be noted that during 2020-2021, the total number of examined brain samples from animals was significantly higher than in 2022, mainly due to a greater number of samples from foxes sent for evaluation of the effectiveness of the oral vaccination campaigns for rabies control. The percentage of these samples from the total number was 61.5% and 75.6%, respectively.

In 2022, only 204 samples with suspicion of rabies were examined, which is nearly five times lower than in the previous year (2021), due to the absence of oral vaccination for wild carnivores and, consequently, the absence of samples from shot foxes. The percentage of positive cases in 2022 was 27.9% of the total examined samples.

Most laboratory examinations were conducted on samples from wild animals, especially foxes, which serve as the reservoir and source of infection. During this period, the proportion of wild animals accounted for 64.4% of the total examined material. Although the percentage of positive results ranged from 1.7%

to 5.5%, it is significantly lower compared to domestic animals (dogs and cats) with positive rates ranging from 4.57% to 25.0% of the total number of examined samples. The reason for this is the presence of samples from healthy foxes as a result of active monitoring, and the average value of 3.0% represents a reliable prevalence rate of rabies within the fox population. On the other hand, the high percentage of positive samples among dogs and cats does not reflect the true prevalence rate, as all these samples were from animals with suspicion of rabies and had a history of clinical signs of the disease.

Comparing the percentage of positive samples from wild and domestic animals to the total number examined, it was found that the proportion of rabid dogs and cats is significantly higher than that of wild animals. The percentage of positive samples from domestic animals averages around 30.0% within each species (Fig. 2). In contrast, the percentage of positive samples from wild animals varies from 2.3% to 15.4%.

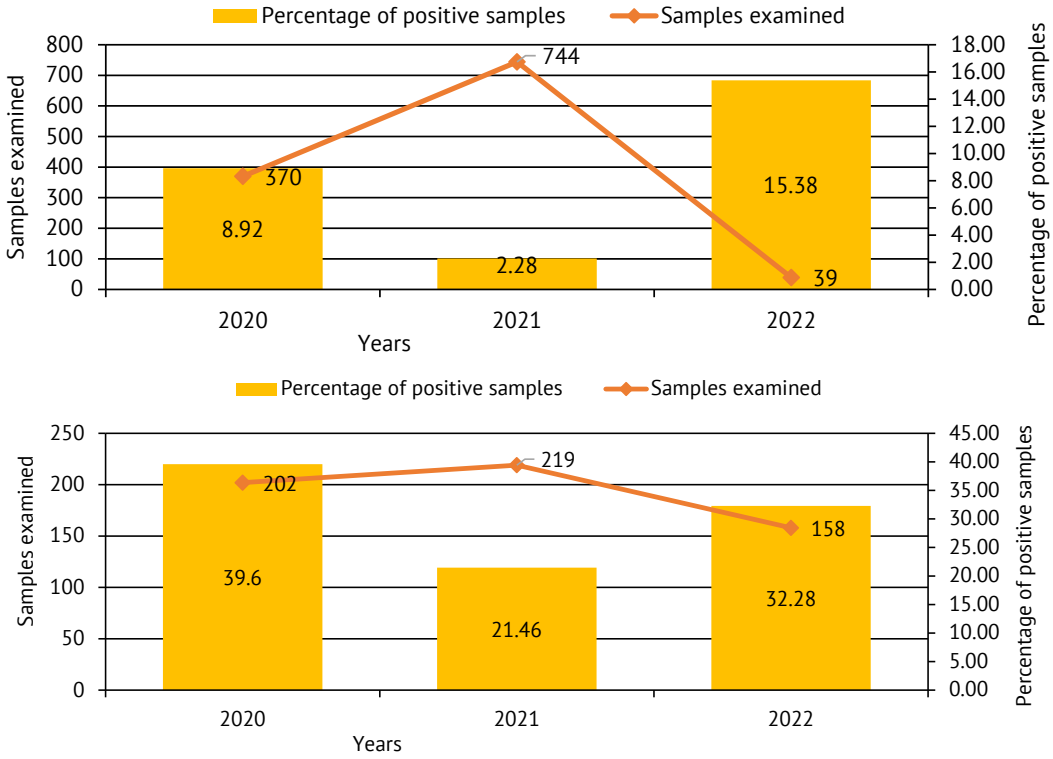

Figure 2. *Dynamics of positive cases as a percentage of the total number of examined samples from wild (A) and domestic animals (B) for rabies*

Source: *compiled based on the veterinary reports of the State Scientific Research Institute of Laboratory Diagnostics and Veterinary Sanitary Expertise (2023)*

The highest incidence rate of rabies is observed among cats, accounting for over 40.0% of the total number of positive cases. Among dogs during this period, the average percentage of positive cases was 32.1% (Fig. 3).

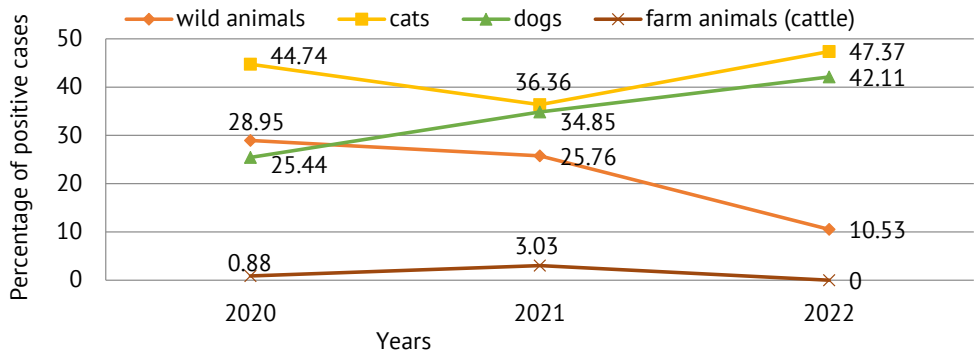

Figure 3. *Number of positive animals for rabies by species (2020-2022)*

Source: *compiled based on the veterinary reports of the State Scientific Research Institute of Laboratory Diagnostics and Veterinary Sanitary Expertise (2023)*

Notably, the percentage of positive cases among dogs increased each year, rising from 25.4% in 2020 to 42.1% in 2022. These indicators suggest the possible emergence of new endemic areas and an increase in the number of anthropurgic manifestations of rabies, due to the higher presence of stray animals. Only 3.2% of the total investigated samples were from other animals. Among them, there were three positive cases in cattle and one positive case each in a badger and a squirrel.

Analysing the seasonality of rabies cases in cats and dogs, it was observed that the highest number of cases occurred at the end of the autumn-winter and the beginning of the spring periods. The percentage of positive cases varied from 6.4% to 57.1% in relation to the number of samples investigated, according to quarterly reports. Among foxes, this indicator remained relatively stable during the quarters of 2020-2021, ranging from 62 to 150 samples, with the highest numbers observed in November and December. Outbreaks of rabies in other animals were predominantly registered during the summer and the autumn-winter periods. The results of the analysis of rabies distribution in the Kyiv Oblast during 2020-2022 indicate an annual persistence of a steady trend in stationary foci and areas with the highest density of rabies cases in western and central districts. Specifically, the highest number of rabies cases in the Kyiv Oblast was recorded in the south-western districts, which border Cherkasy and Vinnytsia Oblasts, where 362 and 415 positive cases were detected during 2020-2022, respectively. The western districts border the Zhytomyr Oblast, where 136 positive cases were registered during the same period. On the northeastern border, which is adjacent to Chernihiv Oblast, only six positive cases were recorded in 2020-2022, while in the Poltava direction, 68 cases were registered.

Analysing the data from neighbouring regions, a clear trend of decreasing rabies cases is observed, which is also reflected in the density of cases in the Kyiv Oblast over the years. The foci remain, but the density of cases is decreasing (Fig. 4).

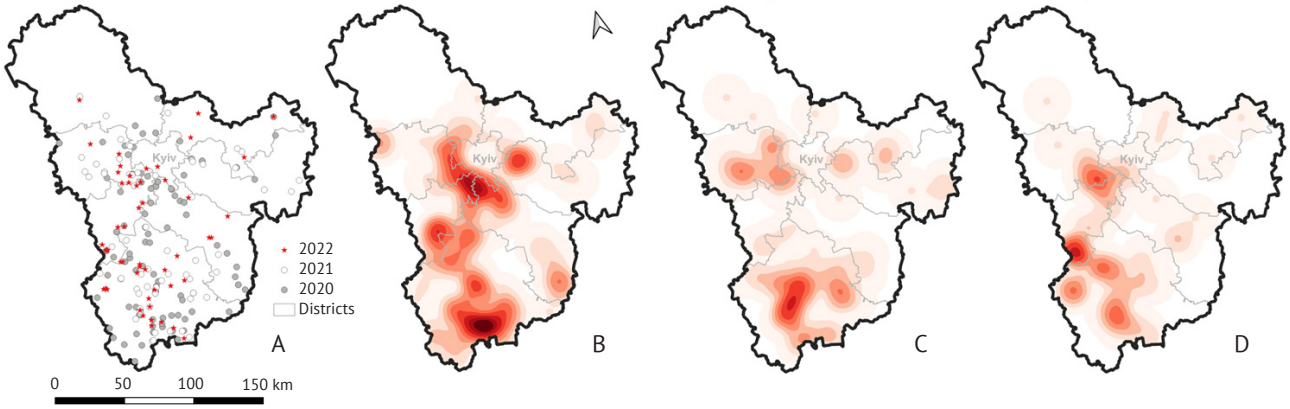

Figure 4. *Spatial distribution of rabies cases over the years (2020-2022). A – rabies cases; B – rabies case density for 2020; C – rabies case density for 2021; D – rabies case density for 2022*

Source: *compiled by the authors of this study*

Analysing the spatial distribution of rabies over the three years (Fig. 4), it was found that zones with the highest rabies case density were observed in the southwestern districts and the central region of the Kyiv Oblast (including Kyiv city). The lowest number of cases was registered in the northern region (exclusion zone and Polissia Reserve), and an average number of cases were recorded in the eastern and northern parts of the region. For example, in the analysis of 2021, it was observed that the zone with the highest density of rabies cases extended from the southern part of Bila Tserkva district to the northwestern border of Fastiv district, forming a dense cluster of cases near the western part of Kyiv, including Bucha, Obukhiv, and parts of Vyshhorod districts. A significant cluster was also present in the eastern part of Kyiv near the border with Boryspil district. In other districts, only isolated cases were registered. In 2021, the zone with the highest case density shifted towards the centre of Bila Tserkva district (up to 10 cases) and extended to the border of two adjacent districts. In the western part of Kyiv, the density of cases shifted to three clusters in Bucha district (up to 5 cases). In the northern region, isolated cases were registered in Vyshhorod and Brovary districts. In the eastern part, there were two clusters in Boryspil and one in Brovary district (up to 3 cases).

In 2022, the highest density of cases was observed in Bila Tserkva district, forming three clusters and isolated cases, which continued with positive cases in Fastiv and Bucha districts, forming a cluster near the western outskirts of Kyiv.

The considerable proportion of domestic animals (cats and dogs) in the etiological structure of rabies indicates a pronounced urban character of the epizootic. Rabies in cats is widespread in almost all districts of the Kyiv Oblast and constitutes the largest proportion of affected animals. In Bila Tserkva district, the cluster is formed by cases among cats and dogs, as well as three

cases in cattle (Fig. 5, B, C, D). The etiological structure of rabies among cats forms the main clusters of density near the outskirts of Kyiv, covering all neighbouring districts. The highest density of cases is maintained in the centre and southwestern part of Bila Tserkva and the western part of Fastiv districts.

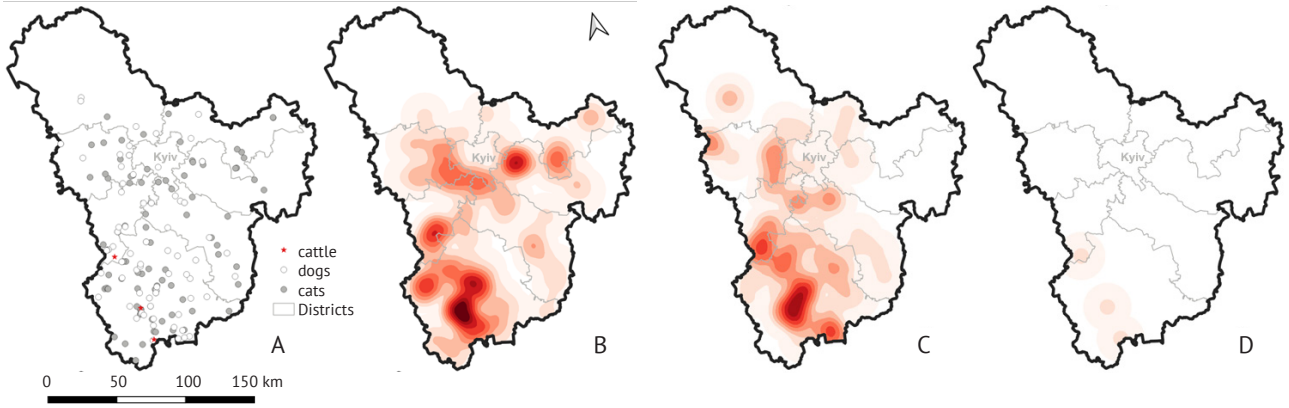

Figure 5. *Spatial distribution of rabies cases by types of domestic and farm animals. A – cases of rabies; B – density of rabies cases in cats; C – density of rabies cases in dogs; D – density of rabies cases in cattle*
Source: *compiled by the authors of this study*

The density of rabies cases among dogs was most frequently recorded in Bila Tserkva and Fastiv districts. Additionally, clusters of two to three cases were registered in all districts of Kyiv Oblast. It is noteworthy that the area of increased density of rabies cases in dogs near the outskirts of Kyiv is considerably distant from the city, unlike clusters of rabies cases in cats, which are located in close proximity to the city. It should be noted that the registered cases of rabies in cattle in Bila Tserkva district – two cases, and Fastiv district – one case, are associated with contact with wild animals (foxes).

Despite the predominant role of domestic animals over wild ones in the total number of rabies-infected animals, the main reservoir of the rabies virus in Kyiv Oblast is foxes. The highest density of rabies cases in wild animals is recorded on the western outskirts of Kyiv (Fig. 6).

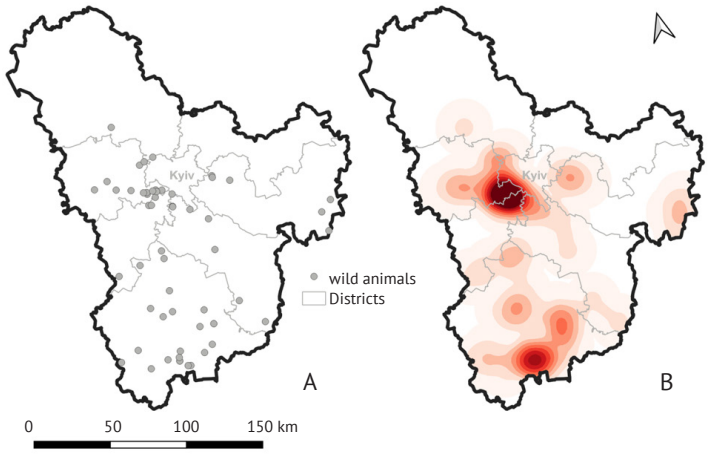

Figure 6. *Spatial distribution of rabies cases in wild animals. (A – rabies cases; B – density of rabies cases)*
Source: *compiled by the authors of this study*

The largest rabies cluster among wild animals is in the central part of Kyiv Oblast, specifically in Bucha and Fastiv districts. Additionally, over 20 cases have been registered in Bila Tserkva district, and up to 10 in Obukhiv and Boryspil districts. Overall, the highest density of rabies cases in Kyiv Oblast is observed in the southwestern and central regions. Persistent clusters of rabies cases are situated in Bila Tserkva district and on the western outskirts of Kyiv, formed by cases of the disease in wild animals.

Regarding the terrain characteristics, the territory of Kyiv Oblast can be divided into three parts: the northern part consists of lowland marshy plains of the Polissia Lowland; the southwestern and central parts lie on the Dnipro Upland (with elevations up to 273 meters); and the eastern, left-bank territory of the region is situated on the floodplain and terraces of the Dnipro within the Dnipro Lowland (Stetsiuk, 2010). The highest number of rabies cases is registered precisely

on the Dnipro Upland of Kyiv Oblast, where predominantly black soil and grey forest soils are found. Through a comparative analysis of the geological features of Kyiv Oblast and the territorial distribution of animal rabies cases, it has been established that the geological characteristics of the region do not play a decisive role in the spread of rabies among animals, unlike the natural and anthropurgic foci of rabies that are located precisely in this part of the region.

It is worth noting that, according to anamnestic data, approximately half of the animals had owners, while the other part of the registered cases belonged to stray animals (up to 50% were cats, and up to 30% were dogs). Therefore, the main cause of rabies cases is inadequate coverage with preventive rabies vaccination and insufficient control over the keeping of domestic animals. The northern districts of the region turned out to be conditionally rabies-free due to the low population density and isolated incidents. Additionally, according to reports by Mazur *et al*. (2017), 80% of owned domestic carnivores were not vaccinated against rabies. Foreign authors (Brookes *et al*., 2019) also emphasize the need for regulating the population of dogs and cats and ensuring an adequate number of planned vaccinations.

Overall, in recent years, Ukrainian researchers Polupan *et al*. (2019) and Makovska *et al*. (2020) have identified a trend of decreasing rabies cases in Ukraine (including Kyiv Oblast), where oral vaccination of wild carnivores against rabies was conducted. This trend continues and is confirmed by our research, as in the last three years, the number of positive cases in Kyiv Oblast decreased by 58.0% and 50.0% compared to 2020, which accounted for 114 cases, while in 2021, there were 66 cases, and in 2022, there were 57 cases.

The research has shown that rabies is most widespread among cats and dogs in Ukraine, which is confirmed by other researchers such as Mazur *et al*. (2017) and Makovska *et al*. (2020). Therefore, combating rabies among domestic animals is still an urgent issue and can only be addressed through joint efforts of administrative and management services, veterinary and human medicine specialists, aimed at improving the care of dogs and cats, timely animal vaccination, capturing, sterilization, and immunization of stray animals, and more. It has been proven that vaccinating the dog population can significantly and durably reduce human rabies deaths, but it requires informative monitoring of animal population demographics.

Geographical approaches using GIS analysis are highly essential tools for the epidemiology of rabies, helping to determine its localization, risk level, and control. These methods are widely used in EU countries (Tadesse & Reda, 2021). In Ukraine, the first attempts were made by Golik *et al*. (2018) on local territories. Makovska *et al*. (2020) made a significant contribution by conducting GIS analysis of rabies distribution in all Ukrainian regions for 2012-2018 and creating a database. These studies allowed establishing temporal patterns and distribution of rabies clusters among different animal species. While our research is specific to Kyiv Oblast, we have identified the highest density zones of rabies foci and the clustering patterns of cases, enabling more effective planning of preventive measures and rabies control in Kyiv Oblast.

Despite the COVID-19 pandemic, oral vaccination of wild carnivores against rabies was conducted in Ukraine in 2020 and 2021, following the "Plan of Anti-epizootic Measures for the Prevention of Main Infectious and Parasitic Animal Diseases in Ukraine (2020, 2021)", which undoubtedly had a positive impact on the tense epizootic situation with rabies. However, in 2022, due to military actions, oral vaccination of wild carnivores against rabies was not carried out. Consequently, the long-term strategy of combating rabies, which relied on extensive oral vaccination of wild carnivores, faces challenges, and may result in significant risks of virus spread among non-immune animals and the emergence of new endemic zones. There is also a possibility of increased cases of anthropurgic rabies due to the growing number of roaming domestic animals.

Given the challenges of today, the development of a novel approach strategy for the rabies control program in animals is necessary. Vaccination has been identified as the most effective means of combating rabies among all animal species. Measures to combat rabies in dogs and cats should include control, vaccination (annual campaigns targeting 70% of animals), and population density reduction through sterilization. As for wild animals, oral vaccination should be conducted twice a year, especially in endemic areas. It is crucial to separately determine the impact of population density on the spread of rabies, which is a complex process and may vary between species. Additionally, it is important to consider that rabies is a transboundary disease (Polupan *et al*., 2019).

Therefore, conducting continuous monitoring with the study and analysis of spatial and temporal patterns of rabies spread, transmission routes, and mechanisms will allow predicting the disease occurrence in different geographical zones, understanding the epizootic situation, and implementing effective measures to combat rabies. An essential step in developing specific differentiated rabies control measures for each individual territory (oblast, district) is studying its territorial affiliation.

CONCLUSIONS

During the period of 2020-2022, the number of registered rabies cases in animals in Kyiv Oblast amounted to 237 cases out of 1788 examined brain samples. There is a trend towards a decrease in the intensity of the epizootic situation: 114 cases were registered in 2020, 66 in 2021, and 57 in 2022.

The highest incidence of rabies was observed among cats and averaged 42.8% (with slight fluctuations in the percentage of positive cases). In dogs, this

rate varied from 25.4% to 42.1%. The highest number of rabies registrations occurred at the end of the autumn-winter and the beginning of the spring period, ranging from 6.4% to 57.1% of the total number of examined samples, according to quarterly reports.

During the analysed period, the highest number of pathological material samples was obtained from wild animals, accounting for 64.4% of the total samples investigated. The percentage of positive cases of rabies in wild animals ranged from 1.7% to 5.5%. The seasonality of rabies during 2020-2021 remained relatively stable and fluctuated within the range of 62-150 samples per quarter, with the highest number of positive cases registered in November and December. Three positive cases of rabies were identified in large ruminants, registered in the Bila Tserkva and Fastiv districts. These cases occurred during the summer and autumn-winter periods and were associated with contact with wild animals, particularly foxes.

The analysis of the results suggests that the spread of rabies in Kyiv Oblast shows an annual steady trend of maintaining stationary foci and areas with the highest density of rabies cases in the southwestern and central parts of the region. Among wild animals, the highest density of rabies foci is found in the central part of the region (in the Bucha and Fastiv districts) and on the western outskirts of Kyiv city. The highest density of rabies cases among cats is registered in the central and southwestern areas of the Bila Tserkva and the western part of the Fastiv districts, as well as in the outskirts of Kyiv city. It is worth noting that the area with an increased density of registered rabies cases in dogs near the outskirts of Kyiv city is significantly distant from the city, unlike the clusters of rabies cases in cats, which are in close proximity to the city.

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CONFLICT OF INTEREST

The authors of this study declare no conflict of interest.

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Анотація. В Україні спостерігається високий рівень циркуляції сказу серед домашніх м'ясоїдних тварин та диких м'ясоїдних. Тому епізоотична ситуація зі сказу в Україні вимагає вивчення поширення цієї інфекції з використанням сучасних інструментів нагляду, що дозволить проводити оцінку територій та визначати зони ризику при аналізі. Метою дослідження було описати просторові характеристики епізоотії сказу в Київській області за 2020-2022 рр. серед диких і свійських тварин. За результатами офіційної звітності було проаналізована загальна кількість досліджених зразків патологічного матеріалу (головного мозку) від різних видів тварин з підозрою на сказ. Позитивні зразки були прив'язані до системи координат та візуалізовані програмним забезпеченням у кластерні випадки сказу по роках і видах тварин з формуванням точкового шару й щільності випадків. За результатами аналізу в Київській області було досліджено 1788 зразків патологічного матеріалу головного мозку від тварин з підозрою на сказ, з яких 237 були позитивними. Найбільша кількість зразків припадає на диких тварин (переважно лисиць), як резервуар інфекції. Частка диких тварин становила 64,4 % від загальної кількості досліджень, але кількість позитивних зразків варіює у межах від 1,7 % до 5,5 %. Порівнюючи з домашніми тваринами (коти та собаки), цей показник сягав до 30,0 % від загальної кількості досліджених зразків. На інші види тварин припадає 3,2 % позитивних випадків від загальної кількості досліджень. Тобто найбільший показник захворюваності спостерігали у домашніх тварин, що становило 72,1 % від загальної кількості встановлених позитивних випадків. Найвища щільність випадків сказу в Київській області спостерігається на південному заході та в центрі. Персистентні кластери випадків сказу розміщувались в Білоцерківському районі та на західній околиці Києва. На заході Києва кластер сформований випадками у диких тварин, котів і собак. В Білоцерківському районі кластер сформований випадками у диких тварин, котів, собак і великої рогатої худоби. Найвища щільність випадків сказу у диких тварин реєструється на західній околиці Києва

Ключові слова: *Rabies virus*; епізоотія; картографування; щільність випадків; кластери випадків