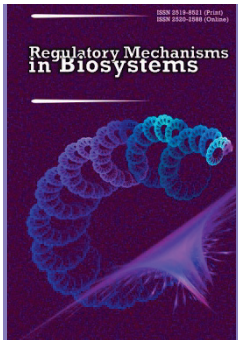

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Impact of military actions on the epizootic situation with the spread of rabies in animals in Kherson Oblast

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Rabies is a zoonotic disease caused by a neurotropic RNA virus of the *Lyssavirus* genus, recorded in various species of wild and domestic animals in many countries of the world, including Ukraine, where this disease has been continuosly diagnosed in animals and sporadically in people. Therefore, there is a need to study the epizootic specifics of rabies in different species of animals as potential sources of threat to people in individual administrative-territorial units of Ukraine. This becomes especially relevant against the background of martial law and the catastrophic flooding which took place in Kherson Oblast. Determining the peculiarities and manifestations of epizootic process of rabies in animals was conducted in the conditions of de-occupied territories of Kherson Oblast in 2023. During that year, 27 studies of samples of pathological/biological materials from animals suspected of rabies were conducted. Those included 24 samples from domestic animals – cattle (*Bos taurus*), dogs (*Canis lupus familiaris*), cats (*Felis silvestris catus*), and 3 from wild animals – fox (*Vulpes vulpes*) and jackals (*Canis aureus*). According to the results, rabies was confirmed in 88.9% of the total number of analyzed samples. Most often, rabies was diagnosed in domestic animals, particularly, dogs and cats – 45.8% and 29.2%, respectively. In the representatives of wild fauna, rabies was detected in 12.5% of the cases, in particular, 8.3% in foxes and 4.2% in jackals. The analysis of the seasonality of rabies morbidity in animals found no pattern in the dynamics. However, according to species, the peak of rabies in foxes took place in autumn, particularly, September and October. An important fact is that the bulk of rabies cases, acccounting for 91.7%, occurred in the period after the Kahovka Dam had been blown up by the Russian Federation. Territorially, during the surveillance period, rabies in animals was confirmed in 23 settlements of Kherson Oblast: 22 cases within the Oblast's districts and one case in the city of Kherson proper.

Keywords: epidemiology of rabies; rabid animals; domestic animals; wild animals; seasonal dynamics of rabies.

Introduction

Rabies is a well-known disease worldwide, which has been known since long before our times. Rabies can affect large numbers of both wild and domesticated animals (Oxford et al., 2016; Cárdenas-Canales et al., 2020). Moreover, this disease is also dangerous to people, and in absence of treatment leads to lethal outcomes (Audu et al., 2019; Fasina, 2019).

Rabies is caused by neurotropic RNA viruses that are classified within Group V of viruses, specifically those with negative single-stranded RNA. Systematically, these viruses belong to the realm Riboviria; kingdom Orthornavirae; phylum Negarnaviricota; class Monjiviricetes; order Mononegavirales; family Rhabdoviridae; and genus *Lyssavirus* (Burrage et al., 1985; Warrell & Warrell, 2004; Ogino, 2022). The genome of the rabies virus consists of a negatively polarized RNA molecule and contains five open reading frames (Fig. 1), located in the following order: 3'-N-P-M-G-L-5'. They encode five proteins: nucleoprotein (N), phosphoprotein (P), matrix protein (M), glycoprotein (G), and RNA-dependent RNA polymerase (L) (Cai et al., 2011; Huang et al., 2017; Oliveira et al., 2020).

According to the International Committee on Taxonomy of Viruses, the *Lyssavirus* genus (RABV) currently consists of 18 species of virus, although their number is continuously growing as researchers in various countries discover new species (Lobo et al., 2009; Hayman et al., 2016; Oliveira et al., 2020). It should be noted that for 15 species of viruses of the *Lyssavirus* genus, the natural reservoir is mammals – representatives of Chiroptera, which play a significant role in spreading rabies among animals and humans (Menozzi et al., 2017; Mantovan et al., 2022).

The rabies virus can be transmitted to all warm-blooded animals. Moreover, a recent study discovered that *Lyssavirus* can remain vital for a long time in cold-blooded animals (Mustafa et al., 2015).

In the literature, scientists have described the two ways that susceptible organisms can be infected by the rabies virus. The first way is the typical way via which the virus enters the organism through contact with infected animals. In such cases, it is evidenced by bites by infected animals. Simultaneously, the rabies virus is inoculated with saliva. A necessary condition for the emergence of the disease is the pathogen infiltrating the nerve fibers, spreading from the peripheral to the central nervous system. Replication of the rabies virus occurs in neuron cells, and at the same time, the virus does not kill those cells, but only impairs their functions. After replication, the pathogen migrates to the peripheral nervous system in the opposite direction (Laothamatas et al., 2008; Fooks et al., 2014; Laothamatas et al., 2016). This is the period when the infected organisms display untypical behavioral and nervous changes (aggression, spasms of various groups of muscles, hydrophobia, intensive salivation), which in total cause the disease to spread via bites.

The second route is atypical. It is considered quite rare and is not related to animal bites. As of now, there have been recorded cases in which the infection resulted from transplantation of the tissues and organs of infected donors to recipients (Krebs et al., 2004; Chen et al., 2017; Lu et al., 2018); consumption of meat of infected animals (Afshar, 1979; Ekanem et al., 2013), and also the disease can be airborne (Gibbons, 2002), although the number of such cases has been low, and thus they are most likely exceptions rather than regular phenomena.

In the wild, viruses of the *Lyssavirus* genus survive in populations of reservoir hosts that are specific to one or another pathogen. Moreover, there is a distinct ecological-geographical confinement to the region where a reservoir host lives, with all the conditions for its intensive breeding and life. In such a site, the continuity of the virus cicle is ensured by its interspecies transmission (Calisher et al., 2006; Hasebe et al., 2007; Smith & Wang, 2013). It has to be noted that there is also intra-species transmission of viruses occurring against the background of competition among living organisms for food resources, ecological niches, etc. (Pool & Hacker, 1982; Badrane & Tordo, 2001; Borchering et al., 2012; Fisher et al., 2018).

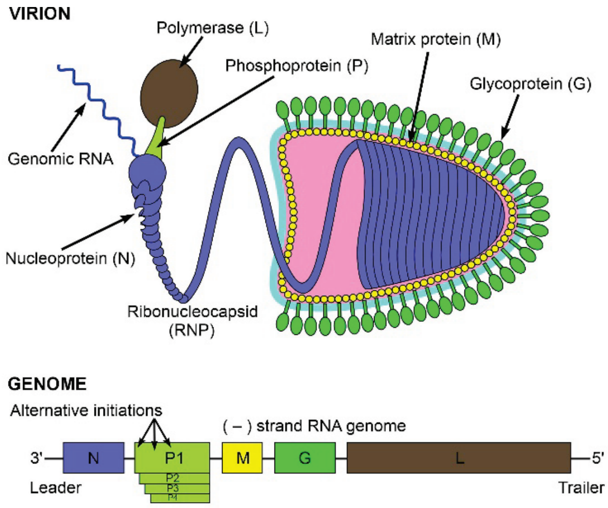

Fig. 1. Virion and genome of the virus of the *Lyssavirus* genus (according to Scott & Nel, 2021)

In different corners of the world, the epizootic process of rabies is sustained by living organisms. In natural hotbeds and neighboring territories, it is mostly maintained through wild animals. In particular, in agrarian regions of Latin America, the spread of rabies in cattle is caused by the bat *Desmodus rotundus* (Hayes & Piaggio, 2018). In Columbia and Peru, bats are also the cause of rabies in dogs and even people (Páez et al., 2003; Condori-Condori et al., 20013). It should be noted that other wild animals such as skunks, foxes, raccoons, and jackals also considerably contribute to the circulation of rabies in various countries around the globe (Macdonald & Bacon, 1982; Gremillion-Smith & Woolf, 1988; Smith, 2002; Gordon et al., 2005; Kemenszky et al., 2020).

In an anthropogenic environment, the cause of rabies in most cases is dogs and cats, and somewhat more rarely carnivores (Cleaveland, 2003; Velasco-Villa et al., 2020). In particular, researchers note that around 99% of cases of rabies in humans are related to the transmission of the pathogen via bites from domestic dogs (Hampson et al., 2009; Hilary Lopes, 2018; Okeme et al., 2020). It has to be noted that cats are also significant in the epizootic process of rabies in the conditions of urbanized ecosystems (Kidane et al., 2016; Fawcett & DeGiuli, 2024).

In addition to the biotic factors, the number of rabies-infected individuals and fatalities is indirectly influenced by factors such as the country's economy, the quality of medical and veterinary services, and the overall financial prosperity of the population. Especially high parameters of rabies-infected people have been noted by researchers in developing countries (Páez et al., 2005; Kardjadj, 2016; Santhia & Sudiasa, 2019).

It should be pointed out that the level of rabies morbidity in animals and humans is also promoted by other factors, including wars and disasters caused by actions of occupiers. The analysis of the epizootic situation with rabies spread in susceptible animals in general, and also individual territories of the country during military actions and after war-caused disasters, is a relevant issue that requires further study. The objective of the study was to analyze the level of rabies morbidity in susceptible animals in the conditions of the de-occupied territories of Kherson Oblast.

Materials and methods

The materials for the study were the official data of the Head Administration of the State Service of Ukraine on Food Safety and Consumer Protection (hereinafter SSUFSCP) in Kherson Oblast (Letter from the Head Administration of the SSUFSCP in Kherson Oblast, No. 2023-2.3-10/1614-24, as of May 23, 2024), provided on the request of the Letter of the Dnipro State Agrarian-Economic University as of May 15, 2023 No. 15-08-0027 On Conducting Laboratory Studies of Parasitic and Infectious Diseases of Animals (Bovine Cattle, Goats and Sheep, Horses, Swine, Productive Poultry) and Their Results in the Context of Districts of Kherson Oblast. The reported data on cases of detection of rabies in susceptible animals in Kherson Oblast (in settlements in de-occupied territories) were provided for the period of 2023 and were confirmed by the reports about the results of studies of pathological (biological) material at the Mykolaiv Regional State Laboratory of the SSUFSCP. For the reported period, the Mykolaiv Regional State Laboratory of the SSUFSCP examined 27 samples of pathological/biological material from animals suspected of rabies, in particular: 3 samples from cattle (*Bos taurus*), 2 samples from foxes (*Vulpes vulpes*), 13 samples from dogs (*Canis lupus familiaris*), 8 samples from cats (*Felis silvestris catus*), and 1 sample from common jackal (*Canis aureus*).

The positive biological/pathological material from the animals was subjected to the descriptive statistical analysis and was classified by seasons of the year, months, species of animals, and administrative units with geospatial coordinates (longitude and latitude). The analysis of material included the study of the general dynamics of morbidity of animals from rabies, providing the characteristics of epizootic process. The conducted analysis was focused on the confirmed positive biological/pathological material from animals, without control with material that negatively reacted to rabies.

Results

According to the 2023 reports of the Head Administration of the SSUFSCP in Kherson Oblast, the Mykolaiv Regional State Laboratory of the State Food Safety Service analyzed 27 samples of pathological/biological material from animals suspected of rabies from settlements of the liberated territory of Kherson Oblast. Of the studied samples, a positive reaction to rabies was confirmed in material collected from 24 animals, which accounted for 88.9% of the total number of studied samples. In general, for the period of reports, the Mykolaiv Regional State Laboratory of the SSUFSCP analyzed 27 samples from domestic (dogs, cats, and bovine cattle) and 3 samples from wild animals (foxes and jackals), which accounted for 88.9 and 11.1%, respectively.

The highest number of confirmed cases, with the positive reaction to rabies, was observed in dogs – 45.8% (Fig. 2). A lower number of rabies-positive samples was from cats – 29.2%. It has to be noted that in cattle and wild animals, the percentage of the total confirmed cases of the disease was the same, equaling 12.5%. The analysis of the percentage of rabies-positive samples from wild animals revealed that the fox population was diagnosed with this disease more often (8.3%) than the population of jackal (4.2%).

The analysis of the reports of Head Administration of the SSUFSCP in Kherson Oblast, found that rabies in the susceptible animals had been observed throughout the year. In percentage aspect, the ratio of the discovered cases of rabies-positive animals had a non-uniform pattern across the locations (Fig. 3).

In May and June, rabies morbidity was detected in the populations of domestic dogs and cats. In particular, one case of rabies was identified in a dog in May, and four cases were diagnosed in cats and dogs (two each) in June. In August, morbidity was observed in wild animals: a case was found in jackals. In September, rabies was recorded in domestic (two cases in dogs) and wild animals (one case in foxes). In October, the pathological/biological material from domestic, agricultural, and wild animals tested positive for rabies (one case in each for dogs, cattle, and foxes). In November, the disease was found only in domestic animals, namely, three cases in dogs and two in cats. In December, rabies was found in domestic and agricultural animals – two cases in dogs, one case in cats, and one case in cattle.

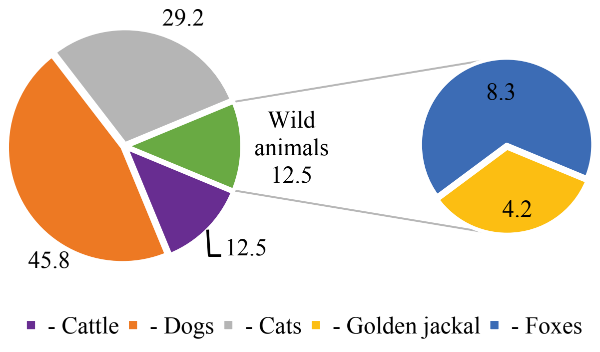

Fig. 2. Percentages of the positive rabies samples according to species of animals (%)

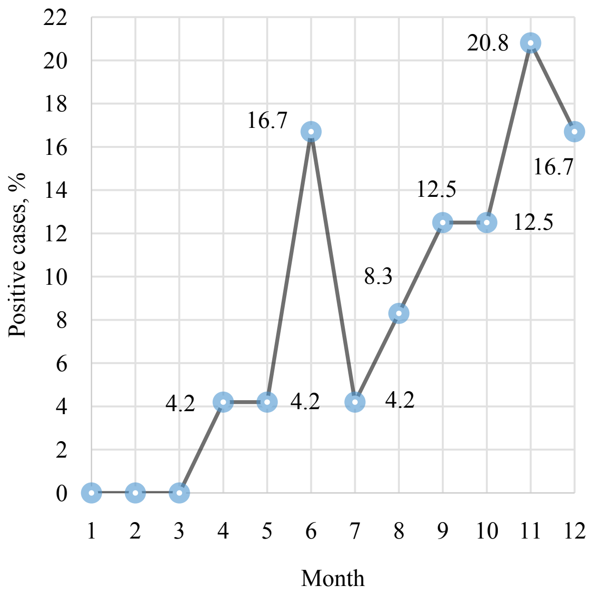

Fig. 3. The seasonality of rabies in susceptible animals in the de-occupied territories of Kherson Oblast in 2023

In particular, during the first three months of 2023, in the de-occupied territory of Kherson Oblast, not a single case of morbidity in rabies-susceptible animals was found. The first cases of rabies were found in April and May. In both those months, the number of sick animals was the same, accounting for 4.42%. A rapid spike in the number of rabies-positive animals up to 16.7% was observed in June, although in July this parameter declined to 4.2%. During the period between August and November, the number of rabid animals gradually grew, in particular, by 8.3% in September, by 12.5% in October, and by 20.8% in November. It has to be noted that in December, the number of sick animals had a tendency towards decline, equaling 16.7%.

It is noteworthy that most of the officially confirmed cases of rabies in domestic and wild animals – 91.7% occurred after June 6, 2023, the day when the Russian Federation blew up the Kahovka Dam.

The analysis of rabies cases in 2023 in different species of animals revealed that in April, the Head Administration of the SSUFSCP in Kherson Oblast received the first report of rabies in agricultural animals, namely cattle (Fig. 4). The analysis of morbidity dynamics by species of animals revealed that the disease peaked in foxes in autumn. In the remaining species of both domestic and wild animals, no seasonalty in the disease manifestation was observed.

According to the documentation provided by the Head Administration of the SSUFSCP in Kherson Oblast for the period, rabies morbidity in susceptible animals was officially confirmed in 23 settlements of Kherson Oblast (Table 1), specifically, 12 cases within Beryslav District and 11 cases within Kherson District, including one case in the city of Kherson.

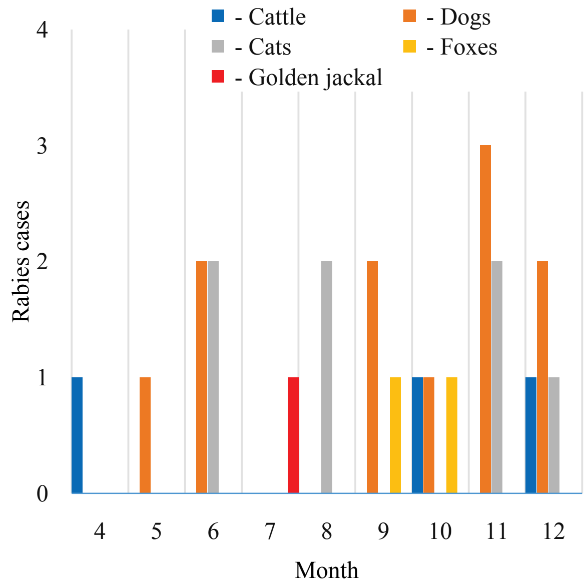

Fig. 4. The seasonality of manifestation of rabies in different animals in the de-occupied territories of Kherson Oblast (N = 24)

Table 1
Distribution of rabies in susceptible animals in the de-occupied territories of Kherson Oblast in 2023

Animal	Settlement	Coordinates
Domestic Animals		
Cats *Felis catus* Linnaeus, 1758	Krutyi Yar	46°46′19″N 32°29′08″E
	Nadezhdivka	46°42′24″N 32°21′42″E
	Burhunka	46°48′43″N 33°13′36″E
	Novovorontsovka	47°29′47″N 33°54′55″E
	Velyka Oleksandrivka	47°19′29″N 33°18′42″E
	Pryhir'ya	47°31′29″N 33°11′48″E
	Vysokopillya	47°29′39″N 33°31′58″E
Dogs *Canis lupus* subsp. *familiaris* Linnaeus, 1758	Molodets'ke	46°41′26″N 32°17′43″E
	Lymanets	46°53′25″N 32°50′54″E
	Novorais'k	47°00′31″N 33°29′08″E
	Dudchany	47°11′11″N 33°46′26″E
	Vysuntsi	46°43′31″N 32°34′54″E
	Novovorontsovka	47°29′47″N 33°54′55″E
	Myroliubivka	46°43′42″N 32°17′38″E
	Bezvodne	47°10′22″N 33°17′04″E
	Bila Krynytsya	47°20′47″N 33°11′24″E
	Novopavlivka	47°22′17″N 33°08′45″E
	Kherson	46°38′24″N 32°36′52″E
Cattle *Bos taurus* Linnaeus, 1758	Chervonyi Yar	47°04′46″N 33°31′32″E
	Molodets'ke	46°41′26″N 32°17′43″ E
	Inhulivka	46°54′21″N 32°56′40″E
Wild carnivores		
Foxes *Vulpes vulpes* (Linnaeus, 1758)	Tavriiske	46°43′32″N 32°06′09″E
	Hrozove	46°44′20″N 32°19′09″E
Common jackal *Canis aureus* Linnaeus, 1758	Sofiivka	46°35′44″N 32°15′17″E

The analysis of the distribution of rabies-positive pathological/biological material from different species of animals in the de-occupied territory of Kherson Oblast revealed that the largest shares, 71.4% and 54.5% for rabid cats and dogs, respectively, were found in Beryslav District. At the same time, cases of rabies were confirmed in foxes and jackals, found only in the territory of Kherson District. It has to be noted that in cattle, the disease was found in equal numbers in Beryslav and Kherson districts.

Discussion

As of now, the criminal large-scale invasion of Ukraine by the Russian Federation has endangered not only the integrity and soverenity of

Ukraine, but also the state of its environment. As is known, any military actions cause direct and indirect impacts on the qualitative and quantitative parameters of natural resources, including those in protected territories. As a result of military actions started by Russia on February 24, 2022, a high number of protected Ukrainian lands have been subjected to military actions, many still suffering to this day, or were temporaryly occupied, and have suffered significant ecological and economic losses. The systematic use of artillery and aviation in places that are turned into battlefields leads to fires and destroys the vegetation. Obviously, animals suffer from negative impacts as well. Many animals are being physically destroyed, affecting both individual animals and entire species. The food base for animals in those territories has considerably deteriorated or became scarce. Furthermore, military actions disturb the animals, forcing them to leave their natural environment and seek for a new one. In new sites, it is hard for the animals to adapt and takes long time. Also, they must compete for food and territory with local species. All those circumstances inflict a great harm on all animals, including rare endemics, characteristic for certain regions or territories. Forced migrations of animals, in particular, wild carnivores, entail new biological threats of emergence and spread of zooanthroponosis infections, in which wild fauna plays a significant role of reservoir. Furthermore, the anthropogenic environments are also threatened by invasion of those diseases, including rabies.

As of now, rabies is a disease that is widespread worldwide, with extremely powerful zoonotic potential. The disease pathogen is a neurotrophic virus that by systematic position belongs to the *Lyssavirus* genus. Currently, this genus includes 18 species of viruses, grouped in four phylogenetic groups. Until 2012, the species diversity of pathogens of this genus comprised only 12 species. However, already in 2022, researchers officially recognized the existence of 16 species (Evans et al., 2012; Hayman et al., 2016; da Silva Schreiber & Fachinetto 2024). Therefore, it is quite likely that their number will soon increase by several more.

The disease is recorded in almost all countries around the globe. In particular, rabies cases were reported in cattle in southern Brazil between 2008 and 2017, as noted by the researchers, who identified 160 outbreaks (Santos et al., 2019). Also, rabies cases in cattle were reported by researchers from Northern Argentina, attributing the outbreaks to the natural reservoir – bats (Delpietro et al., 2009). In Croatia, one case of rabies in a cow was officially recognized, displaying typical clinical manifestations; the cow had been imported to the country (Lojkić et al., 2013). It is worth noting that in different regions of Ukraine, researchers also observed cases of rabies in cattle and goats (Golik et al., 2018; Kornienko et al., 2019; Makovska et al., 2020), although they comprised a small portion of the general number of confirmed cases. This fully correlates with the reports about the epizootic situation in the de-occupied territory of Kherson Oblast, where rabies in cows was confirmed in 12.5% of the rabid animals analysed in the study. Globally, wild carnivores play a crucial role in spreading and maintaining the stationary unfavorable conditions in rabies outbreak sites. In particular, cases of infecton in agricultural and wild ruminants, and also humans from attacks and bites by raccoons have been noted in different years by the researchers in the United States of America, in particular the states of Florida (Bigler et al., 1973) and West Virginia (Plants et al., 2018), and also in Canada (Rees et al., 2011). Also, raccoon dogs have been the cause of rabies outbreaks in China (Liu et al., 2014). Other wild animals besides raccoons that have an important role in the epizootic chain of rabies are wolves and foxes, as evidenced by the data of researchers in numerous corners of the world (Müller et al., 2005; Toma, 2005; Wilde, 2005; Liu et al., 2014), including Ukraine (Avramenko et al., 2020; Makovska et al., 2020).

It should be noted that in Ukraine, among various wild animals, the largest epizootic incidence of rabies transmission to domestic animals and humans stems from foxes, quite rarely by jackals. This tendency has been especially notable in settlements bordering with natural habitats of those animals. However, the results of the retrospective analysis conducted by scientists regarding rabies in Ukraine indicate that, compared to other domestic carnivores, foxes have a lower frequency of rabies transmission to humans and animals (Polupan et al., 2021). The analysis of the reports by the Head Administration of SSUFSCP in Kherson Oblast suggests that such a tendency is completely consistent with the existing data, because for the reported period, the share of wild animals in the total of confirmed rabies cases was12.5%. At the same time, 8.3% of the cases were foxes and 4.2% were jackals.

In an anthropogenically altered environment, the main role in the survival of rabies virus and its tranmission to other vulnerable organisms, including humans, is played by dogs and cats (Moran, 2002; Oertli, 2020; Dieudonné, 2021). Based on the conducted analysis, we may state that a large portion of the officially confirmed cases of rabies in the liberated territory of Kherson Oblast occurred in dogs, accounting for 45.8%. Somewhat lower share was comprised of cats – 29.5%. Therefore, the hypotheses and statements of researchers regarding the role of dogs in epizootics of rabies now have convincing confirmation. Thus, domestic cats and dogs remain a potential threat to humans as a source of rabies spread.

The analysis of the morbidity seasonality parameters in the rabies-susceptible animals revealed that the rabies cases that had been officially confirmed by the Head Administration of the SSUFSCP in Kherson Oblast in general had no distinct dynamics. In particular, a rabies spike of up to 16.7% was recorded in June with its following decline to 4.2% in July. Then, it gradually increased again between August and November. At the same time, the analysis of the rabies morbidity dynamics in species of animals revealed that the autumn period was typical for rabies in wildlife fauna, in particular, in foxes. The studies by Ukrainian researchers indicate a similar tendency towards peak values of rabies morbidity in foxes in the autumn-winter period. The authors attribute those dynamics to the dispersal of foxes' offspring and start of migration to new territories. Moreover, in autum is the work of collecting the harvest using agrarian technologies, when noise from the technical equipment scares off animals from their natural living locations (Kornienko et al., 2019). At the same time, other researchers note that the rabies morbidity in foxes in Ukraine peaks in the winter and spring periods (Makovska, 2020).

We should emphasize the importance of prophylaxis of rabies in populations of susceptible animals by vaccinating both domestic and wild animals. Furthermore, these actions radically reduce the risks of rabies in humans as well. In domestic carnivores, researchers heavily focus on dogs, especially, stray dogs and their necessary annual vaccination by parenteral administration of inactive rabies vaccine Rabistar (Ukrzoovetprompostach, Ukraine). By a number of multi-years studies, the authors have confirmed that 77.7% of the cases of animal attacks on humans are by dogs, and therefore the ratio of rabid-dog attacks on humans is 1:125, evidencing the dire need of vaccination. The effectiveness of parenteral administration of rabies vaccine to dogs was evaluated according to blood serum of the Rabistar-vaccinated animals, confirming that over 56.3% of all the vaccinated animals had a quite high level (0.5 IU/mL) of antibodies to the rabies virus, which maintained at the same level even four months later (Makovska et al., 2021, 2024).

As of now, dogs in Ukraine have acquired the special status of being almost the only animal that is spreading rabies to domestic animals and humans. This situation has aggravated due to the Russian invasion of Ukraine, since many animals, including dogs, in the occupied territories have become stray and thus a complete source of rabies spread. This was confirmed by our studies, where the largest share of the rabies-infected animals consisted of dogs (45.8%).

It has to be noted that due to the Russian invasion of Ukraine, starting on February 24, 2022, Kherson Oblast suffered the occupation by Russian military and for a while the state veterinary medicine structures could not conduct strict anti-epizootic measures, including the program of vaccinating agricultural animals against rabies. Furthermore, in this period, no peroral immunization of wild carnivores was performed according to the Plan of Anti-Epizootic Events for Prophylaxis of the Main Infectious and Parasitic Diseases of Animals. Therefore, the situation with rabies in Kherson Oblast has drastically deteriorated.

Moreover, another negative contributing factor that has exacerbated the epizootic situation with rabies in the considered region is the explosion at the Kahovka Dam on 6 June 6 2023, carried out by the Russian Federation. The The dam breach has led to a water-ecological disaster, entailing consequences such as flooding large areas, losses of valuable and rare species in the flora and fauna, and also human casualties. Once the water level dropped down, the areas covered by water bodies dried up, thus removing the natural barriers and opening way to many wild animals, including those infected with rabies.

We should highlight that because of the aforementioned factors, the state service of veterinary medicine for a long time could not carry out the events for prophylaxis of rabies in domestic animals and wild carnivores, and in some places such an opportunity is still absent. In particular, there were no peroral immunization of wild carnivores against rabies and events oriented at surveilance of consumption of baits with the vaccine, detecting antibodies to the virus in blood serum of the foxes, state surveillance of rabies in the population of wild animals, enforcement of quarantine restrictions and conducting vaccination of all susceptible animals, etc.

Thus, as of fourth quarter of 2024, the rabies morbidity in various species of wild and domestic animals in various geographic zones of Ukraine is not declining, but, on the contrary, has a worrisome upward tendency, as was well demonstrated on the example of Kherson Oblast. During recent three years, such a situation is directly connected with the negative impact of the war and its repercussions. War in Ukraine became a powerful destructive force imposing a heavy legacy on the biotic diversity, manifesting in the qualitative and quantitative changes not only at the level of vitality of individual species, but also entire populations and groups. Therefore, as a result of the military actions and explosion of the Kahovka Dam, there is an ongoing mass destruction of flora and fauna, and pollution of the atmosphere and aquatic resources. In total, this has led to disastrous changes in the established interactions of living organisms. Therefore, in some cases, tendencies have been seen towards dramatic declines in the populations of some animals and excessive increases in other animals. In particular, today, with the ongoing war in Ukraine, hunters are prohibited from hunting animals and birds, and those necessary restrictions have caused growth of the populations of foxes, wolves, raccoon dogs, which are reservoirs of rabies that infect stray animals, often those forsaken by their owners. Obviously, due the full-scale Russian invasion of Ukraine, the State Service of Veterinary Medicine will have to conduct stabilization events for a long time to improve the situation with rabies at least to the level of February 24, 2022.

Conclusions

In the de-occupied territory of Kherson Oblast, during 2023, there were officially confirmed 24 cases of rabies in domestic and wild animals (dogs, cats, cattle, foxes, and jackal), which accounted for 88.9% of the total number of the studied samples of pathological and biological material. The rabies virus in animals was found in 23 settlements of Beryslav and Kherson districts of Kherson Oblast. The highest incidence of rabies was seen in dogs – 45.8%, somewhat lower, 29.2%, in cats. In cattle, the percentage of rabies-positive samples amounted to 12.5%. The share of rabies cases accounted for 8.3% in foxes and 4.2% in jackals. In general, 12.5% of the general number of cases consisted of wild animals. In general, rabies in animals in the liberated part of Kherson Oblast did not exert a clear seasonalty: the first cases were observed in May, and the highest number of infected animals was seen in June and November – 16.7 and 20.8%, respectively. Among different species of animals, the seasonality of rabies was only found in foxes, which was characterized by the disease spike in autumn. The largest number of rabid animals (91.7% of the cases) was observed after the Kahovka Dam had been blown up by the Russian Federation. In Beryslav District, the rabies morbidity was the highest in dogs and cats – 71.4% and 54.5%, respectively. In wild animals (foxes, jackals), rabies was found only in Kherson District.

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