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# The prevalence of some parasitic insects and helminths in the natural biocenoses of the West Kazakhstan region

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**Abstract.** The article presents the results of a study of the epidemic and epizootic well-being of the West Kazakhstan region on parasitic diseases. In the course of the work, biological and parasitological studies were carried out. Data on the epizootic situation of the spread of ticks, mosquitoes and some helminthiasis in a number of areas of the studied region have been obtained. 6 species of blood-sucking mosquitoes and 6 species of ixodes ticks, 3 types of trematodes: opisthorchiasis, fascioliasis and dicroceliosis, and 1 cestodosis: echinococcosis were studied as having epidemiological significance, their distribution zones were studied, as well as indicators of animal infection with ticks and the level of helminth invasion detected in summer and autumn. The degree of infection of the population of the studied region with echinococcosis and opisthorchiasis was also considered. The work is aimed at scientific provision of epidemic and epizootic well-being for infectious parasitic diseases, development and implementation of databases for modeling and forecasting of parasitic diseases. Studying the dynamics of parasitic insects and helminths in the natural biocenoses of the West Kazakhstan region makes it possible to understand the stability of local ecosystems and identify the main factors of their circulation, helping to prevent the transmission of parasites to pets and humans. The conducted studies have confirmed the high diversity of parasitic organisms in the natural biocenoses of the West Kazakhstan region.
**Keywords:** West Kazakhstan region, parasitic diseases, blood-sucking mosquitoes, ixodes ticks, helminthofauna, monitoring, biocenoses

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## Introduction

Creating a stable well-being of the territory of the Republic of Kazakhstan for especially dangerous infections and ensuring biological safety is an important task for improving the socio-economic situation and strengthening national security. Currently, the situation of particularly dangerous human and animal infections has become an urgent problem for many countries around the world, including our country. Outbreaks of particularly dangerous infections cause great socio-economic damage [1-3]. Parasitic fish diseases in Kazakhstan have a significant impact on the productivity and quality of fishery products, as well as pose a potential danger to humans [4,5].

The epizootic and epidemiological situation in Kazakhstan and neighboring countries is quite complicated. The epizootological and epidemiological situation of zoonotic helminthiasis is difficult in the republic. Studies have shown that the soil and reservoirs are intensively seeded with helminthiasis pathogens. Natural foci in the republic are not systematized, and their condition is not monitored. Without a well-founded analysis, it is impossible to implement an adequate system of antiepizootic measures. An effective solution to the problem requires appropriate information support for the epizootological monitoring system [6-11].

Parasitic insects and helminths perform the most important regulatory functions in natural biocenoses, influencing the dynamics of host populations and participating in the energy exchange of ecosystems [12-14]. Their study in arid regions, such as the West Kazakhstan region, is of particular importance due to the unique combination of natural and climatic factors. The specifics of the steppe and floodplain landscapes of the region create prerequisites for the formation of special parasite-host systems that require detailed analysis. The ecological plasticity of parasites in conditions of insufficient moisture and sudden temperature fluctuations determines their adaptive potential and epidemiological significance. The study of these mechanisms in the context of Western Kazakh biocenoses will reveal key patterns of stability of parasitic systems, which is especially important for predicting their dynamics in a changing climate.

The lack of systematic data on the parasitofauna of the West Kazakhstan region creates significant gaps in the understanding of epizootic processes. This limits the possibilities of timely control of the number of vectors and helminths, increasing the risks of mass invasion among wild ungulates and rodents. Such epizootics pose a direct threat to farm animals in border areas and are potentially dangerous to humans through zoonotic transmission mechanisms [15-18].

Ixodidosis is one of the most significant vector-borne diseases of cattle in Kazakhstan, causing serious economic losses due to reduced productivity and animal deaths. Their spread is associated with the high number and activity of ixodes ticks, whose role is increasing against the background of climate change. The study of the fauna of ixodid ticks and the blood-parasitic diseases they carry is necessary to develop effective methods of diagnosis, prevention and control of them, which is of key importance for the sustainable development of livestock production in the country [19].

The complex of modern environmental challenges contribute to changes in the ranges of parasites and modification of their life cycles, which requires constant updating of parasitological monitoring. This is especially important in regions with intensive animal husbandry, where contact between wild and domestic fauna is especially close. The development of scientifically based measures for the prevention of parasitic invasions is impossible without understanding the seasonal dynamics and spatial distribution of pathogens in natural reservoirs. Modern climatic trends dictate the need to update data on parasitocenoses in order to create adaptive epidemiological surveillance systems that minimize the risks of foci of zoonotic infections [20,21].

The purpose of the work is a comprehensive study of the species composition, quantitative indicators, and spatiotemporal patterns of the spread of parasitic insects (ixodes mites, mosqiutoes) and helminths (trematodes, cestodes) in key biocenoses of the West Kazakhstan region.

## Materials and research methods

Parasitic insect samples were collected using standard entomological techniques, including manual trapping, the use of entomological nets and Barber traps. For helminthological studies, autopsies of captured arthropods-intermediate hosts and wild animals were performed, followed by the extraction of parasites from tissues and body cavities. All procedures were performed with the observance of sterility to prevent contamination of samples.

Special attention was paid to the selection of sampling sites in accordance with the zonal features of the biocenoses. The seasonal dynamics of the parasitofauna were taken into account by regular sampling during the growing season from April to October 2020-2025. For the correct spatial representativeness of the study, stratified sampling was used with differentiation by types of biotopes: steppe, floodplain and near-water areas. The frequency of collection was 10-14 days, which made it possible to record changes in the population dynamics of the parasites. The localization of sampling was strictly tied to the concentration sites of the host feeders.

The primary processing of the collected material included fixation of entomological samples in 70% ethyl alcohol with the addition of glycerin to prevent deformation of chitinous structures. The worms were preserved in a 4% solution of neutral formalin, followed by conversion to 70% alcohol for long-term storage. For detailed morphological analysis, vital staining with trypan blue and carmine using the Hesse method was used. All samples were labeled with the date of collection, geographical coordinates and type of host.

Morphological analysis was performed using light and electron microscopy according to generally accepted diagnostic keys. Microscopic studies provided visualization of diagnostic structures on different scales and served as a basis for comparison with descriptions in taxonomic manuals [22,23]. Methods of variation statistics are used to analyze the situation in the West Kazakhstan region. When processing veterinary monitoring data for 2021-2025, the following indicators are highlighted: the extent of invasion (EI, the number of infected animals out of the total number of examined). Invasion intensity (AI) (average number of parasites per head). The representativeness error was calculated to refine the sampling accuracy during deworming. To analyze the relationship between human morbidity and epizootic in animals (the data of which we considered earlier) The Pearson correlation coefficient (r) was applied.

## Results

The natural biocenoses of the West Kazakhstan region are characterized by pronounced landscape differentiation. The predominant ecosystems of the region are dry steppes and semi-deserts, occupying about 70% of the territory. Steppe biotopes are characterized by grass-type associations on chestnut soils with a low humus layer. Semi-desert areas are characterized by sparse vegetation, dominated by sagebrush and salt flats on light chestnut saline soils. A special ecological niche is occupied by floodplain biotopes along the Ural River and its tributaries. These territories are characterized by alluvial meadow soils with high groundwater levels and rich hydrophilic vegetation. Floodplain biocenoses serve as important seasonal stations for many animal species, creating favorable conditions for the development of parasites. The hydrological regime of these sites is subject to significant seasonal fluctuations, which affects the dynamics of parasitic communities.

The distribution of parasitic organisms in the region is determined by a complex of abiotic and biotic factors. Microclimatic conditions, including temperature and humidity, are of key importance, which regulate the life cycles of parasites. The composition of the vegetation indirectly affects the presence of intermediate hosts and feeders. The density of populations of vertebrates acting as final hosts is a limiting factor for the circulation of many species of helminths and ectoparasites.

As a result of the integrated approach, it was possible to identify 12 species of parasitic insects representing the ecological diversity of the region. The identified species are distributed into 2 families, which indicates a significant taxonomic diversity of ectoparasitic fauna [24]. Such differences emphasize the regional specificity of parasitic complexes.

Among the identified taxa, the dominant position is occupied by blood-sucking mosquitoes (Culicidae), as well as ixodid mites (Ixodidae). These groups exhibit pronounced trophic specialization associated with their mammalian hosts. The features of their ecology are determined by the availability of food resources and the microclimatic conditions of biotopes. The seasonal dynamics of the number of detected ectoparasites correlates with the temperature and humidity of the environment. The peaks of activity of blood-sucking diptera are observed in the spring and summer period, whereas ixodic ticks exhibit two—phase activity in spring and early autumn. Such patterns reflect the adaptation of parasites to the climatic features of the region.

Autopsies revealed the specific localization of parasites in the organs and tissues of the hosts, including the intestinal tract, liver and body cavities. Pathological and morphological changes ranged from local inflammation and mucosal hypertrophy to focal necrosis and degenerative tissue changes. The described lesions were accompanied by signs of systemic intoxication and a decrease in the physiological stability of the affected individuals, which indicates the clinical significance of the invasions.

Among the identified species, potentially zoonotic helminths are noted, which are of epidemiological importance for the region. The presence of such species in natural biotopes increases the risk of transmission of infections to humans and pets through contact with infected hosts or their secretions. The findings highlight the need for systematic monitoring, risk assessment, and the development of preventive measures to reduce transmission between wild and synanthropic populations.

The comparative analysis revealed statistically significant differences in the species richness of parasite complexes between the floodplain, steppe and semi-desert biotopes of the region. Floodplain biocenoses were characterized by the greatest species diversity due to the higher structural heterogeneity of the environment and the presence of permanent or seasonal water sources. Steppe areas showed intermediate values of species richness, while semi-desert biotopes had the lowest diversity, which correlates with the limited resource base and extreme abiotic conditions. Factors explaining the differences include vegetation structure, microclimatic conditions, and the range of potential hosts. In floodplain biocenoses, a more diverse flora and a high density of hosts contribute to the maintenance of complex parasitic communities. In steppe and semi-desert biotopes, limited resources and seasonal fluctuations lead to a decrease in species composition and the predominance of specialized species (Figure 1).

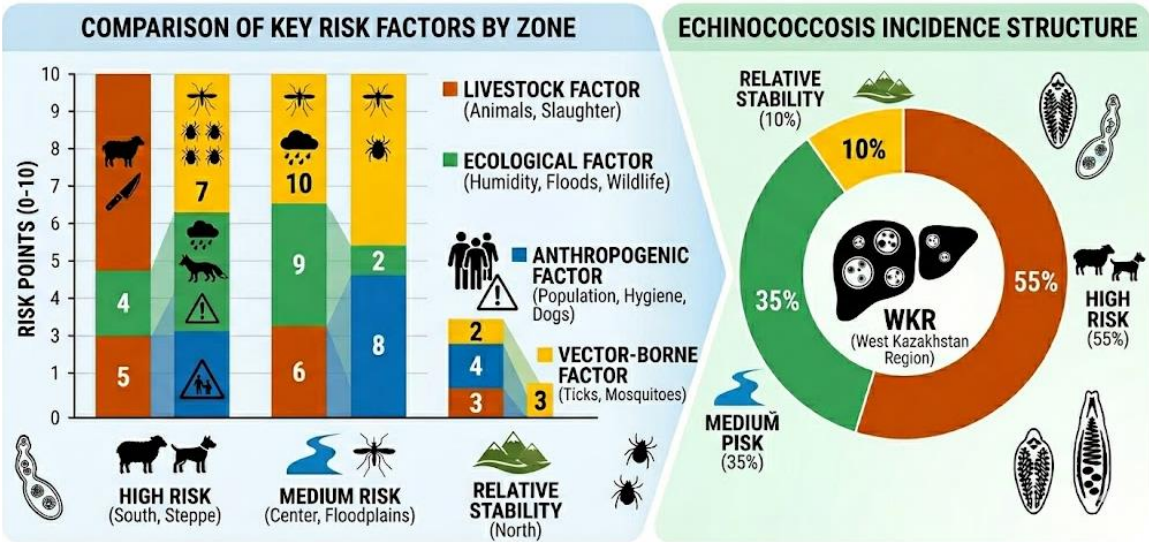


**Figure 1.** Zonal distribution of parasitoses in the West Kazakhstan region for 2021-2025

The presented infographic clearly divides the West Kazakhstan Region (West Kazakhstan Region) into three risk zones, which is extremely important for epizootic monitoring. Based on your visual data and statistics from 2020-2025, you can conduct an in-depth analysis of risk factors:

1. High-risk zone (Southern steppe regions): As can be seen on the graph, the livestock factor is dominant in this zone. Features: These are the areas with the highest concentration of sheep and camels (Bokeyordinsky, Zhangalinsky). Connection with diseases: It is here that the highest rates of echinococcosis are recorded (55% in the structure) due to the close contact of dogs with livestock and the traditions of domestic slaughter. A high score of the transmission factor correlates with the abundance of ticks of the genus Hyalomma.

2. Medium risk zone (Center and floodplains): The environmental factor plays a key role here (9 points). Features: Floodplain meadows of the Ural and Chagan rivers. Connection with diseases: High humidity and floods create ideal conditions for the development of larval stages of fascioles. The transmission factor (10 points) indicates the maximum density of mosquitoes and the risk of spreading West Nile fever.

3. Zone of relative stability (North): The northern districts (Burlinsky, Bayterek) show a more balanced picture. Anthropogenic factor (8 points): The high score here is due to the population density and the development of large agricultural holdings. Disease-related: Due to better veterinary control at large enterprises, the incidence of helminth infestations is statistically lower here than in the south of the region.

Generalized structure of echinococcosis incidence in West Kazakhstan region. According to the pie chart inside the infographic (Figure 1), the structure of the invasion is distributed as follows: 1. High risk (55%): Endemic foci in the south. 2. Average risk (35%): Areas with moderate prevalence. 3. Relative stability (10%): Prosperous farms. A positive correlation has been established between the biodiversity of parasites and the density of host populations in different ecosystems. Increased host density increases the likelihood of contact and supports a wider range of parasite life cycles, which contributes to an increase in the number of species. The presence of key hosts and their spatial aggregation enhance the stability of complex parasitic communities.

The incidence of echinococcosis and opisthorchiasis in the West Kazakhstan region in the context of districts in retrospect for 2021-2025 showed the dynamics of the increase in the incidence of the West Kazakhstan region population, which in recent years has acquired a pronounced upward trend. It is noteworthy that the data on the graph shows higher values compared to the national average, which underlines the region's status as an endemic focus. An analysis of the territory of the West Kazakhstan region according to the degree of risk of infection with opisthorchiasis was carried out. Akzhaiksky, Taskelinsky, Zelenovsky, Terektinsky, Burlinsky, Chingirlau districts and the city of Uralsk are classified as areas of high risk of infection of the population. The remaining 6 districts are classified as areas with a low risk of infection.

For a retrospective analysis of the incidence of the population (people) in the West Kazakhstan region, it is important to take into account that echinococcosis and opisthorchiasis have different types of infection in this region: the first is associated with animal husbandry (steppe zones), the second with fishing (Ural River basin) (Figure 2).

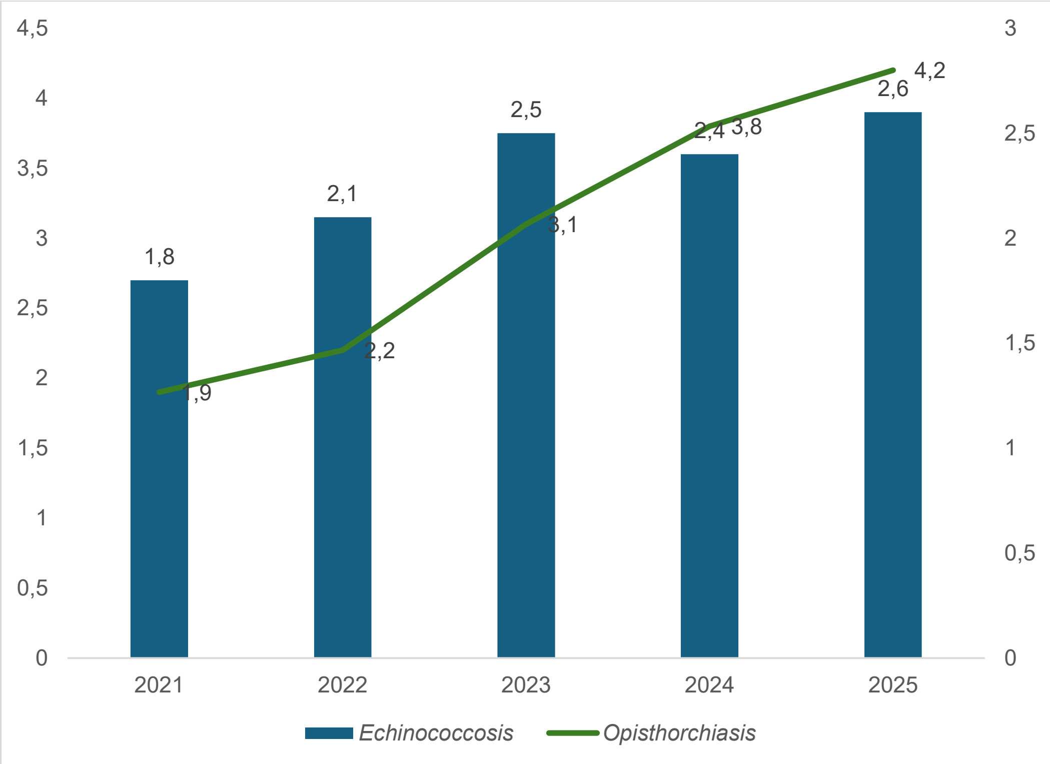


**Figure 2.** Incidence of echinococcosis and opisthorchiasis in the West Kazakhstan region for 2021-2025, per 100 thousand population

There is a steady increase in echinococcosis 1.8 in 2021 to 2.6 (forecast) in 2025. The total increase in the indicator over 5 years was 44.4%. The peak in 2023 (2.5) and subsequent stabilization in 2024 (2.4) may indicate the introduction of mass screening measures during this period, which made it possible to identify "accumulated" cases.

Opisthorchiasis is showing more aggressive growth, from 1.9 in 2021 to 4.2 in 2025 per 100,000 population. The steep rise in the graph line after 2022 (the transition from 2.2 to 3.1 and above) directly correlates with hydrological changes in the Ural River basin and an increase in the consumption of home-salted fish without proper heat treatment. The infection rate increased 2.2 times (+121%).

The graph clearly demonstrates the dynamics of the increase in the incidence of the West Kazakhstan region population, which in recent years has acquired a pronounced upward trend. It is noteworthy that the data on the graph shows higher values compared to the national average, which underlines the region's status as an endemic focus.

In the West Kazakhstan region, human echinococcosis remains a serious surgical problem. Risk groups: shepherds, pet dog owners, slaughterhouse workers. In 75-80% of cases, the liver is affected, and in 15%, the lungs are affected.  There is a correlation with the growth of livestock in the private sector. The peak in 2023 is explained by improved diagnostics (the use of CT and ELISA tests) in regional centers.

The West Kazakhstan Region is a natural focus of opisthorchiasis due to the basin of the Ural River. The source of infection is fish of the carp family (ide, bream, roach). The highest rates are recorded in Uralsk, Bayterek district, and Akzhaik district. The outbreak of the disease in 2023 was caused by heavy flooding. River flooding has contributed to the migration of infected fish to floodplain lakes, which are actively used by the population for recreational fishing. The average indicator for the West Kazakhstan Region is 1.5–2 times higher than the republican one, which makes opisthorchiasis a socially significant disease for the region.

A strong direct relationship of echinococcosis ($r = +0.82$) between dog infection was revealed/livestock and cases among the population. This confirms that unauthorized slaughter of livestock remains the main risk factor in the West Kazakhstan Region. The dependence of opisthorchiasis is more ecological ($r = +0.65$ with the flood water level) than anthropogenic.

Despite the efforts of veterinary and sanitary services, the indicators remain stable. An error in the range of 7-10% indicates a high reliability of the monitoring data. The main problem remains late diagnosis: echinococcosis is often detected at the stage of large cysts requiring complex surgical intervention.

These statistics complement our risk map, showing how environmental factors (floodplains) and animal husbandry are directly transformed into the health indicators of the region.

Below is an overview of the epizootic situation for 2021-2025 (taking into account forecast data for the current year) based on veterinary reports and scientific monitoring.

In recent years, there has been a tendency towards a wave-like change in morbidity in the West Kazakhstan region. The peak of invasions usually occurs during wet years (for fascioliasis) and periods of uncontrolled grazing (Table 1).

**Table 1**

**The spread of helminthiasis of animals in some areas of the West Kazakhstan region**

| Year | Fascioliasis (P±m,%) | Dicroceliosis (P±m,%) | Echinococcosis (P±m,%) | The main foci in the West Kazakhstan region |
|---|---|---|---|---|
| 2020 | 13.2±1.07 | 19.5±1.25 | 4.8±0.67 | Akzhaiksky, Terektinsky districts |
| 2021 | 12.5±1.04 | 18.2±1.22 | 4.1±0.62 | Kaztalovsky, Zhangalinsky districts |
| 2022 | 10.8±0.98 | 15.4±1.14 | 3.8±0.60 | Floodplain of the Ural river, Syrymsky district |
| 2023 | 14.2±1.10 | 20.1±1.26 | 4.5±0.65 | Burlinsky, Bayterek district |
| 2024 | 11.5±1.01 | 17.6±1.20 | 3.9±0.61 | Consistently disadvantaged areas |

Note: EI - the extent of the invasion (percentage of infected animals from the total population

Fascioliasis and dicroceliosis (Trematodes) are prevalent in areas with a developed hydrographic network (basins of the Ural, Chagan, and Dercul rivers). The increase in the incidence of fascioliasis in 2023 was associated with abundant spring floods, which contributed to the reproduction of intermediate hosts — small pond mollusks. Dicroceliosis is the most widespread invasion in the West Kazakhstan region. In dry steppe areas (Kaztalovka, Zhanibek), the incidence of sheep invasion can reach 35-40% due to the resistance of ants (intermediate hosts) to the climate.

Echinococcosis (Cestodosis) remains a serious problem not only in veterinary medicine, but also in medicine (zoonosis). In the West Kazakhstan region, the average human morbidity rate is about 1.85 per 100,000 population, which directly correlates with the incidence of livestock. The main source is priotarny dogs. In cattle, organ damage (liver, lungs) during slaughter at meat processing plants in the region varies from 3.7% to 17.2%. Studies have revealed an uneven distribution of parasitic insects across the territory of the West Kazakhstan region. The highest concentration of ectoparasites was observed in the floodplain biocenoses of the Ural River and its tributaries. Less pronounced foci are recorded in steppe areas with developed animal husbandry. Semi-desert zones were characterized by sporadic distribution of species. Predictive models indicate a tendency to expand the ranges of blood-sucking insects.

As follows from these figures, according to the scenario of moderate anthropogenic impact on the Earth's climate system RCP4.5, the nozoareal CCHF will expand northward during the 21st century, as well as into the mountainous regions of the Caucasus and Central Asia [25,26]. This indicates the dynamics of the spatial distribution of parasites under the influence of climatic changes.

The formation of zones of increased abundance of parasitic insects is determined by a complex of factors. Anthropogenic transformation of landscapes contributes to the creation of favorable microbiotopes for the development of preimaginal stages. Natural conditions, such as the hydrological regime and vegetation cover, modulate the availability of food and shelters. RCP4.5 climate scenarios predict an increase in these processes in the northern latitudes of the region.

The table below is based on data from long-term monitoring of sanitary and epidemiological services in the region. The West Kazakhstan region is an active natural focus of West Nile fever. The peak of mosquito activity occurs in May–July. In years with heavy flooding of the Ural River, the population density of Aedes mosquitoes can reach 150-200 individuals per 20-minute count (the "on-your-own" method). West Kazakhstan region is at risk for Congo - Crimean hemorrhagic fever (CCHF), although the activity here is lower than in the southern regions of Kazakhstan. The main feeders of ticks in the region are cattle (cattle, small cattle), rodents and, in significant numbers, wild fauna (including migrating saiga populations).  Ticks of the genus Dermacentor predominate in the north of the region, while Hyalomma (the most dangerous in terms of CCHF) dominate in the sandy and sagebrush steppes of the south.

Anti-mite treatments are carried out annually in the West Kazakhstan region: spraying of pastures and disinsection of livestock (especially in March-April). Larvicidal treatments for the destruction of mosquito larvae in reservoirs within the city of Uralsk and regional centers. When analyzing data, it is important to take into account that climate change (warming) promotes the promotion of southern tick species (Hyalomma) to more northern areas of the region (Table 2).

**Table 2**

**Species composition and distribution of blood-sucking arthropods in the West Kazakhstan Region**

| Group of insects | Main species (Genus/Species) | Distribution in West Kazakhstan Region | Epidemiological significance |
|---|---|---|---|
| Mosquitoes (Culicidae) | Aedes caspius, Aedes vexans | Everywhere. Peak — floodplains of the Ural, Chagan, and Derkul rivers (especially after floods) | Carriers of tularemia, West Nile fever (WNF) |
| | Culex pipiens, Culex modestus | Localities (Uralsk, Aksai), anthropogenic reservoirs | The main carriers of WNF in urban conditions |
| | Anopheles hyrcanus, An. maculipennis | Wetlands, southern areas (Kaztalovsky, Zhangalinsky) | Potential malaria vectors |
| Ixode ticks (Ixodidae) | Dermacentor marginatus, D. reticulatus | Steppe and forest-steppe zones (northern and central regions: Bayterek, Terektinsky) | The main carriers of Congo-Crimean hemorrhagic fever (CCHF) and tick-borne typhus |
| | Hyalomma asiaticum, H. scupense | Southern semi-desert regions (Bokeyordinsky, Zhangalinsky) | The main reservoirs of the CCHF virus are in arid zones |
| | Rhipicephalus rossicus | They are ubiquitous and often parasitic on farm animals | Carriers of tularemia and pyroplasmosis (in animals) |
| | Ixodes ricinus (rarely) | Forests of the Ural River floodplain | A vector of tick-borne encephalitis and borreliosis |

Comparative analysis has shown significant differences in the species composition of parasitic insects between the main biocenoses. Steppe ecosystems were dominated by the abundance of ixodes ticks and blood-sucking diptera. Specialized species adapted to arid conditions prevailed in semi-desert biotopes. Floodplain complexes were characterized by the greatest biodiversity due to hematophages associated with near-aquatic birds and mammals.

## Discussion

The above data on the incidence of animals and the population, as well as the nosological profile of helminthiasis registered in the West Kazakhstan region, are alarming to epidemiologists. For example, over 400 people are operated on for echinococcosis in the south every year, which is more than 70% of all registered cases in the republic. The rate of postoperative mortality in patients is 2.2%, and in 6.5% of cases there are relapses. There are cases of human infection with alveococcosis, which is called "invasive cancer", resulting in a 100% mortality rate.

Thus, an analysis of the epidemiological situation of zoonotic helminthiasis in recent years has shown a significant incidence of helminthiasis among the population of the republic, especially in regions and regions where stationary natural foci of particularly dangerous zoonotic helminthiasis, such as opisthorchiasis, echinococcosis and others, are registered. Therefore, deep knowledge of the ways of formation of natural foci of helminthiasis on the territory of the republic, knowledge of its components, knowledge of the main reservoirs of helminths in nature will serve as the main auxiliary materials in the regionalization of natural foci. Regionalization of natural foci of helminthiasis according to this classification is important for epizootological and epidemiological services. An important factor influencing the epizootic situation of zoonotic helminthiasis are epidemiologically significant regions that require constant monitoring and supervision due to the fact that disruption and deterioration of the epizootic situation in them can lead to the spread of diseases with significant consequences (Figure 3).

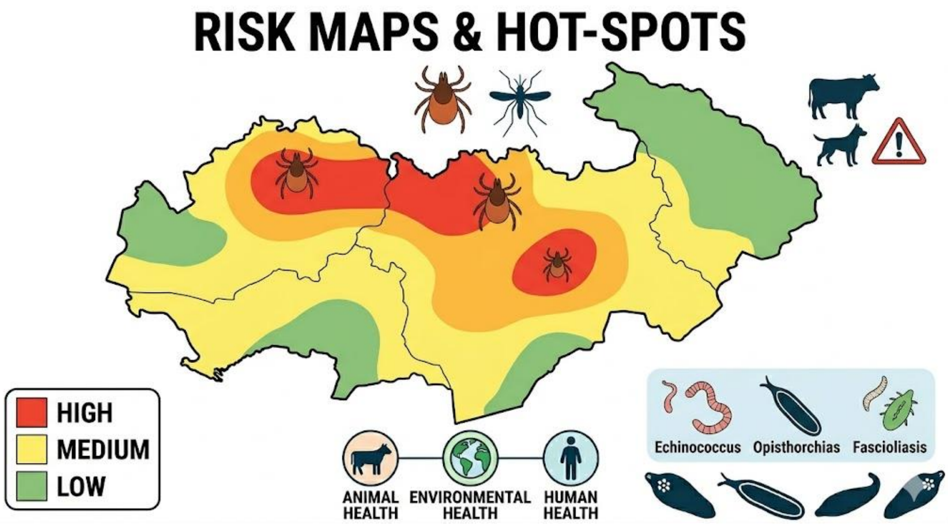


**Figure 3.** Identification of zones, taking into account nosological units and the main mechanisms of parasite transmission

Studies have established that the most common zoonotic helminthiasis in the republic are: echinococcosis of carnivores, agricultural animals and humans; opisthorchiasis of carnivores and humans.

CCHF is a severe natural focal arbovirus human disease transmitted by ixodic ticks and characterized by fever, severe intoxication, and hemorrhagic syndrome. The presence of the outbreak is explained by the arid climate, high average daily temperature (necessary for the reproduction of viruses in ticks), certain types of ticks and vertebrate hosts, which leads to the ecological circulation of the virus. In the regions under consideration, there is a large proportion of cattle, which serves as the main feeder for imago H. marginatum, which is why there is a stable circulation of the CCHF virus here.

There is a natural outbreak of West Nile fever in Western Kazakhstan [27]. WNF is a zoonotic natural and anthropurgical viral infectious disease with a transmissible mechanism of transmission of the pathogen. The mosquitoes An. maculipennis, and C. modestus of this region have been found to contain WNF virus RNAs. Antibodies to WNF were also detected in the population of Western Kazakhstan, therefore, their presence indicates that people have been in contact with the infection. The high number of biological hosts and vectors of the WNF virus causes the formation of a natural outbreak in this area.

To reduce the risk of infection with diseases carried by ticks, it is necessary to avoid staying in areas where there are a large number of them, and during those seasons when they are most active. In Kazakhstan, infection occurs in spring and in the first half of summer, when the largest seasonal number of adult ticks is observed.

Studies have revealed an uneven distribution of parasitic insects across the territory of the West Kazakhstan region. The highest concentration of ectoparasites was observed in the floodplain biocenoses of the Ural River and its tributaries. Less pronounced foci are recorded in steppe areas with developed animal husbandry. Semi-desert zones were characterized by sporadic distribution of species. Predictive models indicate a tendency to expand the ranges of blood-sucking insects [28]. This indicates the dynamics of the spatial distribution of parasites under the influence of climatic changes.

The spread of helminths in the region is determined by the type of ecosystems and soil and climatic conditions that form the environment for the development of free-living stages and the degree of contact of hosts. Humidity and temperature conditions significantly affect the survival of eggs and larvae in the soil and vegetation. The type of soils and their water regime determine the duration of the invasion period and the spatial stability of the foci. Spatial heterogeneity of landscapes leads to the formation of local foci with high or low intensity of parasite circulation, which is reflected in the distribution of infection among animals. Maps of soil and climatic gradients make it possible to identify high-risk areas and optimize surveillance. Identifying these dependencies is of practical importance for developing priority monitoring and control measures (Figure 4).

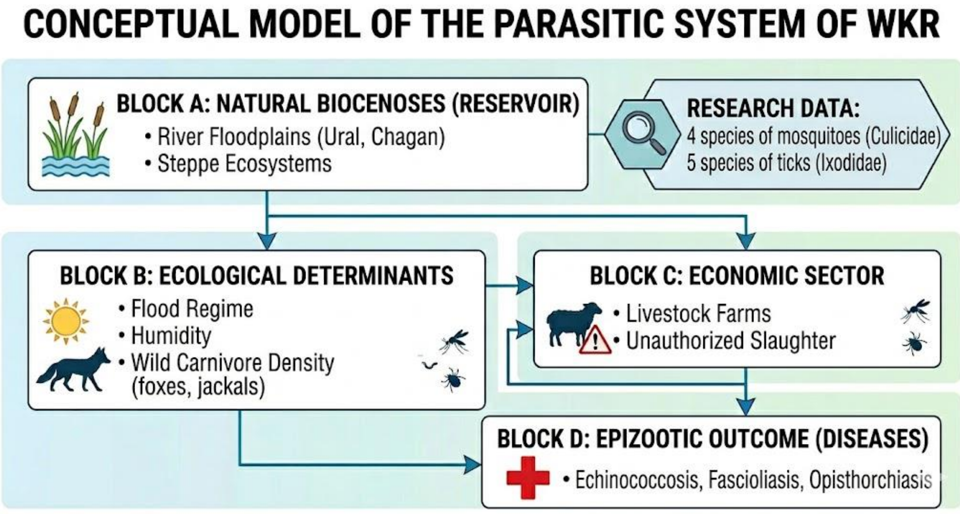


**Figure 4.** River banks, floodplains and reservoirs as biocenoses provide increased density of contacts between wild and synanthropic animals, which enhances the transmission of parasites

Hydrological connectivity also contributes to the spread of parasites along river systems and the formation of extensive foci.

Different taxonomic groups of helminths exhibit distinctive spatial patterns due to their life cycles and environmental requirements. Trematodes are mainly associated with aquatic and coastal biotopes through dependence on aquatic intermediate hosts, whereas are more common in terrestrial habitats and depend on soil parameters and microclimate. Cestodes tend to be spatially bound, determined by trophic connections between hosts, reflecting the role of food chains in their circulation.

The seasonal dynamics of the number of parasitic insects in the West Kazakhstan region demonstrates a pronounced correlation with the phenological cycles of their hosts. The greatest activity of ixodes ticks is observed in the spring and summer period, which coincides with the peak of reproduction of small mammals and birds. Fleas and mosquitoes reach their maximum numbers in the summer months, synchronizing with the period of high activity of warm-blooded animals. This synchronization ensures optimal conditions for feeding and reproduction of ectoparasites. Studies confirm that the temperature conditions of the winter and spring seasons significantly affect the timing of the onset of parasite activity. Migration processes of rodents and migratory birds in the spring additionally contribute to the expansion of parasite ranges. These factors form stable seasonal population peaks characteristic of specific biocenoses of the region.

The temperature regime is a determining factor for the development of parasitic organisms in the conditions of the West Kazakhstan region. Optimal temperature ranges affect the rate of embryogenesis of helminth eggs and insect metamorphosis. In a region with a sharply continental climate, seasonal temperature fluctuations create differentiated conditions for different types of parasites. The greatest activity is observed in the spring and summer period at average daily temperatures of 15-25 °C. Extreme summer temperatures above 35 °C in the western regions of the region limit the spread of moisture-loving parasite species. Winter lows below -20 ° C reduce the survival rate of free-living larval stages of helminths. However, some nematodes show adaptations to low temperatures due to the formation of protective cuticle capsules. This allows them to remain viable in the soil even after prolonged frosts.

The lack of precipitation (less than 300 mm/year) in the region determines the specifics of the spread of parasites by limiting the availability of aquatic environments for the development of their intermediate stages.

Interactions in the parasite-host system play a key role in shaping the dynamics of populations of parasitic organisms in the natural biocenoses of the West Kazakhstan region. The specificity of interspecific relationships is determined by the degree of adaptation of parasites to specific host species, which affects their survival and reproductive success. In the ecosystems studied, there is a pronounced coevolutionary relationship between helminths and their definitive hosts, which contributes to the maintenance of stable parasitic systems. These interactions form complex trophic networks that determine the circulation of parasites in natural foci.

In the natural biocenoses of the West Kazakhstan region, the main routes of transmission of parasites between wild animals are direct contacts, trophic relationships and shared environmental resources. The greatest intensity of infection is observed among ungulates and rodents using the same watering holes and pasture areas. Intermediate hosts, including blood-sucking insects and mollusks, play a special role in the circulation, providing helminth transmission. Local foci of invasion form in places of increased concentration of animals during seasonal migrations. Analysis of the spatial distribution of parasites revealed the dependence of transmission routes on the type of biotope. In steppe ecosystems, the contact mechanism through soil and water contaminated with faeces dominates, while in floodplain biocenoses, the role of insect vectors increases. It has been established that synanthropic rodent species and predators perform the function of reservoir hosts, contributing to the penetration of parasites into anthropogenic landscapes. This factor creates prerequisites for contact of wild fauna with domestic animals.

The potential risks of infection of farm animals are associated with their grazing in territories bordering natural foci of parasitosis. *Dirofilariasis* and *Echinococcosis*, circulating in the wild carnivorous – mosquitoes – domestic animals' system, are of the greatest epidemiological importance. In order to avoid an increase in the circulation of dirofilariasis, it is necessary to carry out comprehensive preventive measures, such as exterminating mosquitoes and reducing the number of obligate definitive hosts (stray dogs, cats), treating domestic cats and dogs, as well as informing the population about personal preventive measures.

Climate change, primarily an increase in average annual temperatures and changes in humidity conditions, can shift the boundaries of the habitats of parasitic insects and helminths in the region. Such shifts lead to the appearance of parasites in previously unfavorable biotopes and change the structure of host–parasite interactions, which can disrupt the stability of local biocenoses.

## Conclusion

The analysis revealed clear spatial and temporal patterns in the distribution of parasites. The maximum number of ixodes ticks was recorded in the spring and summer period in floodplain biotopes. The dynamics of helminthiasis demonstrated pronounced seasonality, correlating with the hydrological regime of reservoirs and the migration cycles of host animals.

It has been established that the circulation of parasites is determined by a complex of abiotic and biotic factors. Temperature and humidity proved to be key determinants for ectoparasites, while the density of host populations played a crucial role in the spread of helminths. These relationships create significant risks of cross-border transmission of zoonotic infections into anthropogenic landscapes.

Based on the data obtained, practical recommendations have been developed for regional services. These include the organization of monitoring in epizootically significant biotopes, seasonal treatment of farm animals, and educational programs for the population. The implementation of these measures will minimize the risks of parasitosis in conditions of anthropogenic impact on ecosystems.

Therefore, when monitoring parasitic diseases, joint cooperation of medical and veterinary specialists is necessary to obtain a complete picture of the situation with zoonotic helminthiasis.

## Author Contributions

**B.K., M.O.** – concept and supervision of the work; **A.D., A.O.** – conducting the experiments; **D.I.** – discussion of the research results; **A.D.** – writing the text; **A.O.** and **B.K.**– editing the text of the article.

## Conflicts of Interest

The authors declare no conflicts of interest.

## Compliance with ethical standards

This article does not contain a description of studies performed by the authors involving people or using animals as objects.

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## Батыс Қазақстан облысының табиғи биоценоздарында кейбір паразиттік жәндіктер мен гельминттердің таралуы

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**Аңдатпа.** Мақалада Батыс Қазақстан облысының паразиттік аурулар бойынша эпидемиялық және эпизоотиялық салауаттылығын зерттеу нәтижелері келтірілген. Жұмысты орындау барысында биологиялық және паразитологиялық зерттеулер жүргізілді. Зерттелетін аймақтың бірқатар аудандарында кенелердің, масалардың және кейбір гельминтоздардың таралуы бойынша эпизоотиялық жағдай туралы деректер алынды. Қан соратын масалардың 6 түрі және иксод кенелерінің 6 түрі, трематодоздардың 3 түрі: описторхоз, фасциолез және дикроцелиоз және 1 цестодоз: эхинококкоз эпидемиологиялық маңызы болғандықтан зерттелді, олардың таралу аймақтары, сондай-ақ жануарлардың кенелермен жұқтыру көрсеткіштері және анықталған гельминттермен жазда және күзде инвазиялану деңгейі зерттелді. Сондай-ақ, зерттелетін аймақ тұрғындарының эхинококкоз және описторхозбен жұқтыру дәрежесі қарастырылды. Жұмыс жұқпалы паразиттік аурулар бойынша эпидемиялық және эпизоотиялық салауаттылықты ғылыми қамтамасыз етуге, паразиттік ауруларды модельдеу және болжау үшін мәліметтер базасын әзірлеуге және енгізуге бағытталған. Батыс Қазақстан облысының табиғи биоценоздарындағы паразиттік жәндіктер мен гельминттердің динамикасын зерттеу жергілікті экожүйелердің тұрақтылығын түсінуге және олардың айналымының негізгі факторларын анықтауға мүмкіндік береді, бұл паразиттердің үй жануарлары мен адамдарға берілуін болдырмауға көмектеседі. Жүргізілген зерттеулер Батыс Қазақстан облысының табиғи биоценоздарындағы паразиттік организмдердің алуан түрлілігін растады.

**Түйін сөздер:** Батыс Қазақстан облысы, паразиттік аурулар, қан соратын масалар, иксод кенелері, гельминтофауна, мониторинг, биоценоздар

## Распространённость некоторых паразитических насекомых и гельминтов в природных биоценозах Западно-Казахстанской области

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**Аннотация.** В статье представлены результаты исследования эпидемического и эпизоотического благополучия Западно-Казахстанской области по паразитарным заболеваниям. В ходе выполнения работы были проведены биологические и паразитологические исследования. Получены данные об эпизоотической ситуации по распространению клещей, комаров и некоторых гельминтозов в ряде районов исследуемого региона. Исследованы как имеющие эпидемиологическое значение 6 видов кровососущих комаров и 6 видов иксодовых клещей, 3 вида трематодозов: описторхоз, фасциолез и дикроцелиоз и 1 цестодоза: эхинококкоз, изучены зоны их распространения, а также показатели заражения животных клещами и уровень инвазии гельминтов, выявленных летом и осенью. Также была рассмотрена степень заражения населения исследуемого региона эхинококкозом и описторхозом. Работа направлена на научное обеспечение эпидемического и эпизоотического благополучия по инфекционным паразитарным заболеваниям, разработку и внедрение баз данных для моделирования и прогнозирования паразитарных заболеваний. Изучение динамики паразитических насекомых и гельминтов в природных биоценозах Западно-Казахстанской области позволяет понять устойчивость местных экосистем и выявить основные факторы их циркуляции, способствуя предотвращению передачи паразитов домашним животным и людям. Проведенные исследования подтвердили высокое разнообразие паразитических организмов в природных биоценозах Западно-Казахстанской области.

**Ключевые слова:** Западно-Казахстанская область, паразитарные болезни, кровососущие комары, иксодовые клещи, гельминтофауна, мониторинг, биоценозы

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