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Safeguarding Beef Cattle from Gnats and Gadflies in the Southern Tyumen Region

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ABSTRACT

An important challenge for the effective development of animal husbandry in Russia is mitigating the damage caused by blood-feeding dipteran insects, which transmit pathogens responsible for various dangerous diseases affecting both humans and animals. It is also necessary to develop comprehensive strategies for protecting livestock from these pests. The present study was conducted to safeguard beef cattle from gnats and gadflies in the Southern Tyumen region. This article presents extensive observations on the seasonal patterns of blood-sucking dipterans, known as "gnats" (including horseflies, mosquitoes, midges, and biting midges), as well as gadflies, in the southern Tyumen region. The authors have identified the peak flight periods of these insects for each natural and climatic zone in the area, highlighting when protective measures for cattle are most necessary. In the southern taiga subzones and mixed aspen-birch forests, such measures should be carried out from late May to the end of August, while in the forest-steppe zone, they should be carried out from early June to the first 5 days of September.

Keywords: Protective measures, Beef cattle, Blood-sucking dipterans, Gadflies, Mass flight

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Introduction

Beef cattle breeding is a key sector of the agro-industrial complex in the Russian Federation. Despite the challenging climatic conditions, agriculture, including cattle breeding, has flourished in the Tyumen region. Since 2002, the region has focused on advancing beef cattle production. Drawing on both domestic and international experiences, a regional program was created to boost beef cattle breeding, aiming to increase production to meet the requirements of processing industries and to expand the sale of purebred meat animals within the region and beyond. The growth of beef cattle breeding in Russia plays a crucial role in supporting the sustainable development of rural areas, ensuring the population has access to high-quality beef, which is vital for food security. Additionally, this growth contributes to the competitiveness of the Russian economy and improves the well-being of its citizens. In the Tyumen region, the specialized beef cattle population has increased by 5.8% over the last three years, reaching 14,032 heads in 2018. The industry is continuing to expand, with 50 entities in the region involved in breeding specialized beef cattle, including 10 legal entities, 40 private farms, and individual entrepreneurs [1].

The growth of beef cattle breeding heavily relies on maintaining the health of livestock and boosting productivity by addressing the damage caused by parasitic arthropods, particularly insects like "gnats" and gadflies. In the Tyumen region, blood-sucking Dipterans are a significant factor in the reduction of livestock products during the

summer grazing season. It is widely believed that during the peak midge season, the weight gain of young cattle decreases by 25-40% [2, 3].

The negative impact of blood-sucking Dipteran insects on animals includes blood loss, intoxication from saliva injected during feeding, inflammation at bite sites, and a general decline in health and immunity. A large-scale midge infestation can result in severe intoxication, known as simuliidotoxicosis, which can often be fatal. Additionally, these insects are vectors for various invasive and infectious diseases that affect both animals and humans [4-9].

Mosquitoes are known to transmit approximately 50 different infectious diseases, including bacterial, parasitic, and viral types. Diseases such as malaria, dengue, encephalitis, and yellow fever, are all carried by mosquitoes, resulting in millions of fatalities each year [10].

Various species of horseflies are known to carry pathogens responsible for several dangerous conditions, such as anthrax, leptospirosis, tularemia, anaplasmosis, infectious anemia in horses, necrobacteriosis in reindeer, besnoitidosis in cattle, setariosis, poliomyelitis, emphysematous carbuncle, trypanosomiasis (su-auru), and hemosporidiosis, among others [11].

Midges, on the other hand, act as mechanical vectors for diseases like tularemia, anaplasmosis, and onchocerciasis in cattle, along with anthrax, glanders, leprosy, and plague [12].

Some studies, both domestic and international, have established that blood-sucking biting midges play a role in transmitting pathogens of diseases such as bluetongue, tularemia, onchocerciasis, and bird hemosporidiosis [13].

The condition known as hypodermatosis, caused by subcutaneous gadflies (*H. bovis* and *H. lineatum*), also leads to significant losses in animal husbandry. Animals affected by gadfly larvae experience reduced appetite and subsequent weight loss. In lactating animals, milk yield can drop by eighty to 200 liters. Young animals experience slowed development and growth, while the weight gain of both young and adult animals may decrease by 13 to 18 kilograms [Ministry of Agriculture of the Russian Federation, Order No. 514 of November 16, 2004, "Guidance on subcutaneous gadflies control and prevention of cattle hypodermatosis"].

In addition, affected animals show lower resistance to other diseases. The leather industry also suffers, as skin damaged by gadfly larvae loses up to 60% of its value. Cattle killed in the spring/summer period in areas where larvae are present often exhibit unmarketable carcasses. After cleaning, up to one and a half kilograms of meat is lost. The stress caused by gadfly and gnat attacks, along with the frantic search for shelter, often results in injuries that can lead to infections such as necrobacteriosis or even abortions in pregnant animals [14].

Hypodermatosis is widespread both within Russia and internationally. According to Marchenko [15], the prevalence of cattle hypodermatosis in Stavropol ranges from 12.0-38.0%. In Kabardino-Balkaria, the average infestation rate is 13.8% [16], while it is also common in the Chechen Republic. In the lowlands, *H. bovis* and *H. lineatum* are found in 56.7% and 43.3% of cattle, respectively. In the foothill zone, the prevalence is 64.3% for *H. bovis* and 35.7% for *H. lineatum*, while in the mountainous zone, the rates are 97.6% and 2.4%, respectively [17].

Outside of Russia, the incidence of hypodermatosis varies based on diagnostic techniques. A 2003 study in Spain showed infection rates ranging from 21.0 to 79.0%, in Belgium the rate was 43.0%, and in Italy, it was 85.0%. Research in Greece (2004) revealed an infestation level of 44.2% [18].

In both the Russian Federation and internationally, macrocyclic lactone-based medications such as ivermectin, hypodectin, eprinomectin, dermacin, abamectin, and avermectin, are commonly used to treat animals infected with subcutaneous gadfly larvae [19, 20].

At present, a key priority for advancing animal husbandry in the country is mitigating the damage caused by blood-sucking Dipteran hematophagous insects. These insects carry pathogens responsible for numerous diseases harmful to both humans and animals. Developing effective and comprehensive protective measures for livestock is essential. The present study aimed to safeguard beef cattle from gnats and gadflies in the Southern Tyumen region.

Materials and Methods

The Tyumen region plays a vital role in the Russian economy, and despite its challenging climatic conditions, agricultural development, particularly in beef cattle breeding, has been thriving. The region is notably marked by distinct latitudinal zoning, with the southern agricultural section (excluding the Khanty-Mansiysk and Yamalo-Nenets Autonomous districts) having three main natural and climatic subzones: small-leaved aspen and birch

forests, southern taiga, and forest-steppe, each shaped by unique climate characteristics and varying heat and moisture ratios.

The research was conducted between 2017 and 2019 in the entomology and disinsection lab, as well as the animal entomosis laboratory, of the All-Russian Scientific Research Institute of Veterinary Entomology and Arachnology (VNIIVEA), a branch of the Tyumen Scientific Center of the Siberian Branch of the Russian Academy of Sciences. The study focused on the seasonal dynamics of "gnats" and gadflies across all three natural and climatic subzones through systematic pasture counts. Horseflies were monitored every 5-7 days using cone-shaped traps [21]. Mosquitoes, biting midges, and midges were captured between 7-8 pm with an entomological net and removable bags [22]. The intensity of insect attacks was measured using the average data from 10 strokes across 10 repetitions, corresponding to a single attack on animals. Surveys occurred every 5 days.

The adult gadfly population was tracked visually with binoculars, counting at least ten animals at a time. Counts were performed during peak insect activity hours, from eleven am to three pm, throughout the flight period, with average values calculated [23]. The mass flight periods were determined using the "Method for determining the harmfulness of insects commonly referred to as 'gnats' for cattle" [24].

Results and Discussion

In the Tyumen region, 154 species of blood-sucking Diptera are found, including 43 species and one subspecies of horseflies, 44 species of mosquitoes, 45 species of midges, and 22 species of biting midges [25-27]. In the southern part of Tyumen oblast, only 1 species of gadfly, *Hypoderma bovis*, parasitizes cattle [28].

Monitoring the seasonal fluctuations in the population of parasitic Dipterans helps determine their flight periods, the intensity of their attacks, and the resulting potential impact on cattle meat production. This data supports the decision-making process for the timing and implementation of protective measures for livestock.

In the southern taiga, the flight period for insects commonly known as "gnats" spans one hundred thirty to one hundred forty-five days, from mid-May until the first ten days of October. The mass flight phase typically lasts about ninety days, from late May to the end of August.

In the aspen-birch forest subzone, gnats are active from the second 10-day period of May until the first ten days of October, lasting around 150 days. During favorable years for gnat development, the mass flight occurs from the last 5 days of May to the end of August, approximately ninety to 95 days.

The forest-steppe zone experiences a longer flight period for blood-sucking insects, from mid-May to mid-October. Mass flight is observed from early June to the middle of the first ten days of September, lasting around 95 days.

The emergence of adult gadflies varies across the region's climatic zones. In the southern taiga, adult gadflies begin to appear in the first ten days of July. The highest number of gadflies is seen between the second 10-day period of July and the first ten days of August, and their activity continues until the end of August, with a total flight period of about two months.

In the small-leaved aspen and birch forests, the initial appearance of gadflies occurs during the third ten-day period of July. Their peak population is observed from the 2nd ten-day period of July to the first ten days of August. Some gadflies can still be found until the first ten days of September.

In the forest-steppe zone, the overall flight period of gadflies spans from the second ten-day period of June to the 3rd ten-day period of August, lasting about 70 days. Mass flight occurs predominantly in July. These phenological dates may fluctuate by approximately 20 days depending on seasonal weather conditions.

Upon reviewing the flight periods of blood-sucking Dipterans, it becomes apparent that as one moves from north to south within the region, both the total duration of the flight and the mass flight periods naturally extend. The local hydrometeorological conditions significantly influence the dynamics and population levels of these insects, causing considerable variation in the timing of their emergence and disappearance. The prolonged maintenance of breeding grounds due to adequate moisture facilitates the successful completion of preimaginal stages and leads to higher adult insect populations. Conversely, sudden temperature drops and extended rainy periods during the flight phase tend to reduce gnat numbers.

Table 1, based on the duration of the mass flight periods of the various insects referred to as "gnats," outlines the optimal times to implement protective measures against these insects. In the southern taiga and aspen-birch forests, protective interventions should be scheduled from late May to the end of August, while in the forest-

steppe zone, the period extends from June to the close of August. However, these dates may shift by 10 to 20 days depending on spring and summer weather conditions.

Table 1. Flight times of gnats and gadflies, and carrying out protective measures in the south of the Tyumen region

Insects	Flying insects by 10 days																	
	May			June			July			August			September			October		
	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2		
Southern taiga																		
Horseflies																		
Mosquitoes																		
Midges																		
Biting midges																		
Gadflies																		
Dates of protective measure implementation																		
Aspen and birch forests																		
Horseflies																		
Mosquitoes																		
Midges																		
Biting midges																		
Gadflies																		
Dates of protective measure implementation																		
Forest-steppe																		
Horseflies																		
Mosquitoes																		
Midges																		
Biting midges																		
Gadflies																		
Dates of protective measure implementation																		
Note:																		
Total flight period																		
Mass flight period																		

Conclusion

The timing for implementing protective measures for cattle against insects known as “gnats” and gadflies is influenced by the population of these insects and the season of their mass flight. These periods differ across the natural and climatic zones of the region: in the southern taiga and small-leaved aspen-birch forest subzones, mass flights occur from the end of May through August, while in the forest-steppe zone, it typically spans from early June to the first days of September. These periods can shift by 10-20 days depending on seasonal weather conditions. The primary factor for deciding when to implement protective measures is the abundance of gnats and gadflies that can fluctuate considerably. In years with unfavorable conditions for these insects, such as sudden cold spells, extreme heat, or drought, the number of Dipterans tends to be low, and the mass flight period may be shortened or absent. In such years, when the “gnat” and gadfly do not significantly affect animals, carrying out preventive measures would not be cost-effective.

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