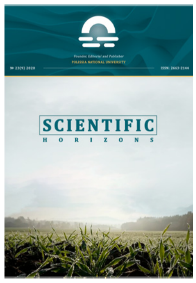
SCIENTIFIC HORIZONS

Journal homepage: https://sciencehorizon.com.ua
Scientific Horizons, 24(7), 20-29



UDC 595.773.4-15-167-19:631.2(477):619
DOI: 10.48077/scihor.24(7).2021.20-29

Fauna and Ecology of Dipterous (Díptera, Muscidae) Livestock Biocenoses of Ukraine

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Article's History:
Received: 10.09.2021
Revised: 09.10.2021
Accepted: 12.11.2021

Suggested Citation:
Paliy, A., Palii, A., Rodionova, K., Koreneva, Zh., & Kushnir, V. (2021). Fauna and ecology of Dipterous (Díptera, Muscidae) livestock biocenoses of Ukraine. *Scientific Horizons*, 24(7), 20-29.

Abstract. The biology and ecology of parasitic insects are closely related to the life of people, and the leading role belongs to animal husbandry. It is difficult to overestimate the negative influence of parasitic dipterans on productive animals, especially during the season of their mass reproduction and distribution. The work aimed to study the species composition of Diptera in different livestock biocenoses in eastern and central Ukraine. Entomological nets and traps were used to capture zoophilic flies, the number of insects was determined using the fly index, and luminescent markers TAT 33 with a powder fraction of 30 microns. The collected insects were identified according to the existing modern identifiers. As a result of the studies, the presence of *Musca domestica* (Linnaeus, 1758) was determined in all livestock facilities for keeping animals and birds. The largest number of house flies was noted in the facilities for keeping sows with suckling pigs (312.0±35.3) and fattening animals (277.5±6.1). *M. domestica, M. autumnalis*, and *S. calcitrans* accounted for 75.57% of the entire complex of zoophilic flies. The species *M. vitripennis, M. tempestiva, L. irritans, H. atripalpis* also occupied an important place among the species that form the entomoparasitocenosis (18.91%). In pasture biotopes, two species of flies (*Ortellia caesarion* Meigen and *Ortellia cornicina* Fabr.) have been identified. They do not attack animals, but are mineralisers of cattle feces. Luminiferous marker L-1 basic green (TAT 33) fixes well on insects and lasts for 5 days. The density of the fly population in the pig houses is 36% higher than in the calf houses. The results obtained are the basis for the development of innovative, scientifically grounded schemes for control and the fight against parasitic insects at livestock enterprises

Keywords: zoophilic flies, species composition, *Musca domestica*, population size, agrobiocenosis, luminophore, marking

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INTRODUCTION

Today, there are approximately 1.5 million, 5.5 million, and 7 million species of beetles, insects, and terrestrial arthropods in the world, respectively [1]. Among a large number of insects, some are herbivores and provide invaluable benefits to the ecosystem [2]. Some insects feed on organic substrates or are predators of other species [3; 4]. Insects, which lead a parasitic lifestyle, are of the greatest sanitary-epidemiological and epizootic importance [5].

True flies (Muscidae), one of the large families of the suborder Diptera (*Brachycera*), are distributed throughout the world, and about 5000 species from 100 genera have been described in the world fauna [6; 7]. The population of flies is characterised by their diversity, wide geographic and spatial distribution [8]. Flies can lay eggs on several types of substrates, which in turn allows them to colonise many regions [9]. There is competition between different species of flies in nature, which manifests itself in behavioral characteristics during feeding and reproduction [10].

On the territory of livestock biocenoses of the forest-steppe and steppe zones of Ukraine, 27 species of zoophilic flies have been identified, among which species of the Muscidae family dominate (74.1%). At the same time, the largest number of parasitic Diptera species was recorded in livestock buildings for keeping cattle, and a minimum of species was recorded in buildings for keeping poultry [4]. Due to significant climate changes, it is necessary to control the dominant species of zoophilous flies by studying their biology and ecology in the field on the territory of Ukraine.

Under the conditions of Colombia, the most abundant species are *B. normata* (24.31%), *Biopyrellia bipuncta* (20.60%) and *Pseudoptilolepis nigripoda* (15.82%), with the latter two species preferring uninhabited territories [11]. In Brazil, Colombia and Costa Rica, eight genera of Muscidae were collected, including 28 species: *Cyrtoneurina* (2 species), *Cyrtoneuropsis* (8 species), *Dolichophaonia* (1 species), *Neomuscina* (7 species), *Ophyra* (1 species), *Phaonia* (2 species), *Philornis* (5 species), and *Polietina* (2 species) [12]. To date, 153 species of blowflies (*Diptera, Sarcophagidae*) have been recorded in Turkey [13]. 3314 Stomoxyini flies belonging to the genera *Stomoxys, Haematobosca, Haematostoma* and *Haematobia* were collected from zoos, livestock farms, wildlife sanctuaries and the national park of Thailand, and eight species were identified: *S. calcitrans* (46.6%), *S. uruma* (26.8%), *S. pulla* (4.3%), *S. indicus* (0.7%), *S. sitiens* (0.1%), *H. sanguinolenta* (11.2%), *H. austeni* (0.5%) and *H. irritans exigua* (9.8%). At the same time, the diversity of Stomoxyini flies on livestock farms is higher than on other objects of study [14]. The wide distribution of flies of various species is established at an altitude of over 1200 meters above sea level [15].

Stomoxyini flies (Diptera: Muscidae) include parasitic fly species of medical and veterinary importance. Adult flies feed on mammalian blood and can transmit some parasites and pathogens. Adult *H. irritans* are constantly found in cattle in winter, and their numbers increase from late July to late August [16]. Seasonal fly activity shows one large peak in late summer and a second, smaller peak just before the end of the flying season [17]. The number of flies in a particular object also depends on the presence of their biological enemies: the genus Spalangia [18], *Hydrotea aenescens* [19].

Individual species of flies exhibit different behavior when parasitising on animals. It was found that *Haematobosca stimulans* (Mg.) And *Stomoxys calcitrans* (L.) feed from the back, side and legs of the animal. The fly *Haematobia irritans* (L.), as a rule, parasitises on the back, legs and udder nipples of animals, and *Musca autumnalis* Deg. was found mainly on the head of animals. The species *Hydrotaea irritans* (Fall.) has noticeable daily fluctuations in activity and was found on the head, abdomen, and udder nipples of animals [20]. From *Stomoxy*s spp. on cattle farms, *Stomoxys calcitrans* (91.5%), *Stomoxys indicus* (7.9%) and *Stomoxys sitiens* (0.6%) are the most widespread. Seasonal and daily activity of *S. calcitrans* was observed during a 1-year period, and the peak of daily flight activity in males fell on 10 a.m. and 4 p.m., while in females the activity increased throughout the day – up to 4 p.m. [21]. Other data indicate that the peak of daily activity of *Stomoxys spp.* was between 2 p.m. and 4 p.m. [22].

House flies play an important role in the mechanical transmission of various pathogens [23]. More than 130 pathogens, mainly bacteria (including some life-threatening species), have been identified from house flies. Antimicrobial resistant bacteria and fungi isolated from house flies have also been reported [24]. Thus, a study of 160 flies revealed on their surfaces the presence of *E. coli* (73.8%), and in their digestive tract – *P. aeruginosa* (100%). The most commonly isolated bacteria from flies are *P. aeruginosa, Salmonella* serogroup D, *S. dysenteriae*, *E. coli, C. freundii, S. aureus*, and *S. epidermidis* [25]. The fly *Hydrotaea irritans* (Fall.) is a vector of summer mastitis in cows [20]. Gene sequence analysis revealed that the most common classes of bacteria found in house flies on farms included Bacilli, Clostridia, Actinobacteria, Flavobacteria, and Proteobacteria, as well as Corynebacterium, Lactobacillus, Staphylococcus, Vagococcus, Weissella, Lactococcus, and Aerococcus [26]. At the same time, microorganisms isolated from flies exhibit increased resistance to antimicrobial drugs [27; 28]. *Musca domestica* L. plays a leading role in the transmission of exogenous forms of ascaridates and esophagostomas, and *Musca autumnalis De Gree* may be a source of environmental pollution with trichostrongylates [19]. In the conditions of the canine center, the fly *Musca domestica* L. is a source of pollution of livestock objects with exogenous forms of helminths *T. canis* and *T. vulpis*. The species *Muscina stabulans* F. and *Stomoxys calcitrans* L. can be the source of the distribution of *A. caninum* larvae and *T. vulpis* eggs, respectively [29].

A multidimensional approach that controls all life stages of the housefly while simultaneously preserving natural enemies of the flies can be an environmentally sustainable way to keep fly populations below maximum allowable limits [30; 31]. Despite the study of this issue, some species of flies are being redescribed today [32], new species are being discovered [33].

Due to the relevance of the problem of parasitic insects to agricultural science, the work was aimed to study the species composition of dipterans (Díptera, Muscidae) of different livestock ecosystems in the Eastern and Central Ukraine.

MATERIALS AND METHODS

The capture of zoophilic flies was carried out in May-October in livestock facilities, pastures and summer camps for keeping animals. For this purpose, entomological nets and traps were used [34]. Field studies were carried out following current methods [35]. The number of flies was determined using the fly index (FI) (counting the number of flies per 10 animals and determining the average) [36].

To assess the insect population size, we used TAT 33 fluorescent markers with a powder fraction of 30 microns: basic green (L-1), basic violet (L-2), basic blue (L-3) (manufactured by Noxton Technologies, Ukraine). Labeled insects were indicated in a dark room using an OLD-1 illuminator for fluorescent diagnostics. Light compositions were applied by dry powder pollination [37]. The calculation of the average headcount indicators and confidence intervals was calculated by the method of R. Dajo (1975). The essence of this method is that part of the individuals is caught from the population, marked and then released into the same population, and after a day, part of the individuals is caught again and the population density is determined:

$$N = \frac{a \times b}{\mathrm{c}} \tag{1}$$

where a –marked and released flies; b – recaptured flies in a day; c – including marked flies; N – absolute number of flies.

Under laboratory conditions, the collected insect larvae were cultivated in a thermostat at a temperature of 20-25°C in glass containers with a volume of 1000 cm^3. As a medium for larvae growing, bran moistened with water in a ratio of 3:1 and cattle feces were used. Insect puparia were kept on wet sand [38].

The adult flies were cultivated in the boxes of the insectarium, where the preset microclimate was automatically maintained: temperature 25-27ºC, relative humidity 55-65%, light period 16 hours. Adults of *Musca domestica* received glucose, whole milk, and water. A multicomponent nutrient medium consisting of milk powder, glucose, and stabilised bovine blood was used to feed the gray oviparous cowshed *Musca autumnalis*, and fresh cattle feces served as a medium for oviposition and development of larvae [39]. To feed the stable fly *Stomoxys calcitrans*, cattle blood stabilised with citric acid glucose solution was placed in the cages. For the development of larvae, we used a multicomponent medium consisting of alfalfa flour, wheat bran, dry yeast, cholesterol, dextrose, and nystatin [40]. To feed the glittering dung flies *Ortellia caesarion* Meigen, a mixture of milk powder with glucose in a ratio of 1:3, fresh milk, and water were used. Fresh cattle feces were placed daily for egg laying and larval development [41]. The flies were kept in cages measuring 25×25×25 cm.

The collected insects were identified according to the existing determinants [22; 42-44]. Collections of Diptera insects are kept in the collection of the National Scientific Center "Institute of Experimental and Clinical Veterinary Medicine" of the National Academy of Agrarian Sciences of Ukraine.

RESULTS AND DISCUSSION

As a result of studying the diversity of the species composition of zoophilic flies in livestock biotopes in eight regions of Ukraine (Fig. 1), the presence of 27 mass species of zoophilic flies in livestock facilities for cattle, pigs, sheep and poultry was established.

It was found that the greatest diversity of dipterans, 25 species, was noted in livestock biocenoses for keeping and grazing of cattle, in farms for keeping and raising pigs 7 species of flies were noted, in livestock facilities for keeping small ruminants – 5 species, and in poultry premises – 4 species of flies. The species diversity of Diptera in livestock biocenoses for keeping and grazing of cattle is maintained due to the peculiarities of the biology (feeding and reproduction) of zoophilous flies. At the same time, *Musca domestica* (Linnaeus, 1758) was recorded in all livestock facilities for keeping animals and in poultry houses. The poultry houses had the smallest number of fly species. This is because flies do not attack birds, but they pose a problem in egg collection and grading facilities.

The species composition and the number of dipterans (Díptera, Muscidae) in different biotopes of livestock agroecosystems in the eastern and central Ukraine have been studied (Table 1).

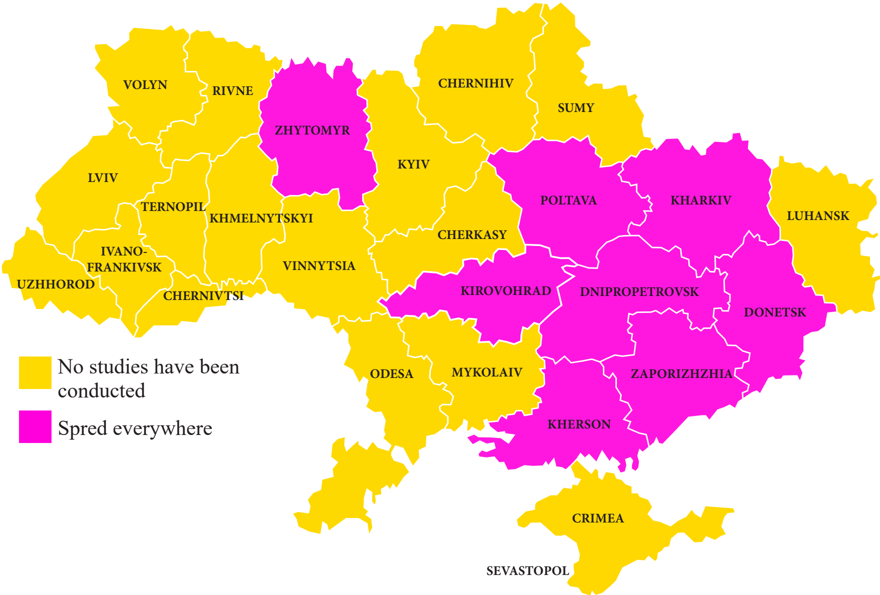

Figure 1. *Distribution of parasitic dipterous in different regions of Ukraine*

Table 1. *Species composition and the number of the main zoophilic flies in the biotopes of livestock agrobio-cenoses*

Species of flies	Number of captured flies	Pasture	Summer camps	Premises	% from total number
Musca domestica (Linnaeus, 1758)	3250	21	1604	1625	32.25
Musca autumnalis (De Geer, 1776)	1629	653	965	11	16.17
Musca larvipara (Porchinskiy, 1910)	232	137	93	2	2.30
Musca vitripennis (Meigen, 1826)	627	467	160	3	6.25
Musca tempestiva (Fallén, 1817)	582	317	263	2	5.78
Morellia simplex (Loew, 1857)	112	36	76	–	1.11
Morellia hortorum (Fallén, 1817)	95	40	54	1	0.94
Stomoxys calcitrans (Linnaeus, 1758)	2736	58	1857	821	27.15
Haematobia irritans (Linnaeus, 1758)	324	86	217	21	3.22
Haematobosca stimulans (Meigen, 1824)	121	94	19	8	1.20
Haematobosca atripalpis (Bezzi, 1895)	369	123	243	3	3.66

As you can see from the data in Table 1 livestock agrobiocenoses are represented by 11 species of zoophilic flies, of which the housefly *M. domestica* makes up 32.25% and it occupies the main biotopes – summer camps and livestock facilities. The gray oviparous cowshed *Musca autumnalis* makes up 16.17% and lives mainly in pastures and summer camps. Stable fly *S. calcitrans* – 27.15%, lives mainly in livestock facilities and summer camps. These three species account for 75.57% of the total complex of zoophilous flies. Of the remaining 9 species, *M. vitripennis, M. tempestiva, L. irritans*, and *H. atripalpis* should be noted, which also occupy an important place among the species that form entomoparasitocenoses (18.91%). The population of the remaining 4 species is small (5.55%) and does not play a significant role in the entomoparasitocenosis.

When studying pasture biotopes, we noted two species of flies that do not attack animals, but are utilisers of cattle feces – *Ortellia caesarion* Meigen (glittering dung fly) and *Ortellia cornicina* Fabr. (green dung fly). These two species *O. caesarion* and *O. cornicina* can compete for the habitat with the parasitic *M. autumnalis*. The larvae of zoophilic flies *M. larvipara, M. vitripennis, M. tempestiva, M. simplex, M. hortorum* develop in the feces of cattle, adult females attack animals in the area of the eyes, nostrils, and also feed on exudate from wounds and abrasions. The males of these species of flies feed on vegetation and do not attack animals. Zoophilic flies of the species *L. irritans, H. stimulans, H. atripalpis*, as well as the stable fly, feed on blood, both females and males. According to our observations, the adults of *H. stimulans* lead a trapping lifestyle.

The biology of the preimaginal stages of *O. caesarion* and *O. cornicina* is the same as in *M. autumnalis*, but the biology of the adults is different. Thus, *M. autumnalis* is an ectoparasite of cattle, while *O.caesarion* and *O. cornicina* do not attack animals. In the summer period (July), green dung fly and glittering dung fly can occupy the dominant among the complex of fly larvae that inhabit cattle feces. So, we found that the mass of excrement ranged from 10219 to 33542 g per 1000 m² (on average – 21880.5 per 1000 m²) of the pasture area. The main mass species of Diptera larvae inhabiting these biotopes were: *M. autumnalis, O. caesarion* – up to 85%, *M. hortorum* – 5%, *M. larvipara* – 3%, the remaining 7% were occupied by *Scatophaga stercoraria* (Robineau-Desvoidy, 1930) and other types.

A different number of the dominant species *M. domestica* was noted in premises for various economic purposes (Table 2).

***Table 2**. Population of the housefly M. domestica in livestock premises*

Animals kept in different premises	Number of premises	Number of animals	Number of flies per one animal
Pigs			
Single and gestating sows	5	469	145.0±19.7
Sows with suckling piglets	5	435	312.0±35.3
Young animals 2-4 months of age	5	2138	53.3±8.7
Animals for fattening	5	4732	277.5±6.1
Boars	5	27	351.8±11.2
Total	25	7801	Average 227.9±39.5
Cattle			
Calves	5	534	258.3±83.4
Cows	5	858	36.9±8.3
Total	10	1392	Average 147.6±45.9

As can be seen from Table 2, the largest number of house flies 312.0±35.3 and 277.5±6.1 was observed in the premises for keeping sows with suckling piglets and fattening animals, respectively. In cattle, a high number (258.3±83.4) was noted in the premises for keeping calves. Since the parasitism of house flies occurs in warm livestock buildings, their reproduction lasts all year round and can reach up to 10 generations, which can explain its high number. In order to study the density and migration of flies, the technique of marking insect individuals with recapture and determination of the proportion of marked insects was used. First, in laboratory conditions, the duration of luminophore fixation on the body of insects was determined (Table 3).

***Table 3**. Duration of luminophore fixation on the body of flies*

Luminophore	The number of flies in the experiment	Glow color	Duration in days					Death of flies on day 5
			1	2	3	4	5	
Immersion marking								
L-1	50	Green	+	+	+	+	+	1
L-2	50	Purple	+	+	+	±	±	–
L-3	50	Blue	+	+	+	±	±	1
Control	50	–	–	–	–	–	–	–
Pollination marking								
L-1	50	Green	+	+	+	+	+	–
L-2	50	Purple	+	+	+	±	±	1
L-3	50	Blue	+	+	+	±	±	–
Control	50	–	–	–	–	–	–	–

***Note**: "–" – no glow; "+" – intense glow; "±" – weak glow*

It was found that both marking methods ensure reliable fixation of phosphors on the body of flies. The L-1 marker was clearly visible for five days. In flies treated with L-2 and L-3, on the 4th day, the luminescence gradually faded away, and on the 5th day it was almost not noticeable. Pollination marking turned out to be easier and more convenient, so it was later used on farms. To determine the density of insects in a production environment, 3 livestock facilities for keeping calves and sows with piglets were taken (Table 4).

***Table 4**. The absolute number of flies in livestock facilities by marking and recapturing*

Animal groups	Square, m^2	Flies caught and released	Flies caught after marking in 24 hours		Absolute number		Average density per m^2
			Total	Marked	Average	At 95% confidence interval	
Pigs for fattening	1000	3000	3000	24	375.0±91.3	266.6–631.9	375.5±91.3
Sows with suckling piglets	1000	5000	2500	38	328.9±59.1	248.8–485.1	328.9±59.1
Sows with suckling piglets	1000	3000	1000	19	157.9±45.2	108.6–289.4	157.9±45.2
Calves	550	2000	2000	43	93.0±14.9	73.5±133.2	93.0±14.9
Calves	550	3000	3000	72	125.0±15.3	101.4–162.9	227.3±27.8
Calves	550	1000	1000	46	43.5±6.9	33.7–61.3	79.1±12.5

As you can see from the Table 4, the highest density of the fly population was in the premises for keeping pigs and amounted to 328.9-375.5 individuals per 1 m^2, while in the calf houses this indicator was 227.3 individuals per 1 m^2.

The authors suggest that the method of marking and recapturing is quite accurate, but it also has a number of technical difficulties. This determination requires more than two days of time, you must have special equipment. Therefore, for those cases when the high accuracy of determining the number of flies is not of fundamental importance and where a large number of determinations are required (many premises of farms), a more accessible and quicker express method for determining the number of flies is needed.

In this regard, the authors drew attention to the possibility of determining the relative number of flies in the premises where animals are kept using the fly index. The time spent on determining the FI in one room does not exceed 30 minutes.

For catching flies, the authors used special traps, the use of which was recommended by a number of other researchers [14; 22]. It has also been found that traps are effective means of reducing the number of flies on cows during the grazing season [45].

Based on the results of our research, it was found that the housefly in livestock agrobiocenoses is the most adapted species and it perfectly adapted to the conditions of livestock facilities. The number of *M. domestica* is relatively high throughout the year, although fluctuations have been noted in winter. The housefly fly index does not fall below 30 individuals per animal (December, January). The authors believe that this is due to the fact that in livestock buildings, even with the observance of all sanitary standards for removing manure, there are still hidden breeding places. In the stall, the number of cows, air humidity and lighting conditions are the most likely factors to influence their distribution [17].

Despite the fact that the greatest problem for poultry farms is the parasitisation of mites [46], we also determined the presence of 5 species of Diptera in production facilities (*Musca domestica, Muscina stabulans, Fannia scalaris, Fannia canicularis, Drosophila funebris*). It is believed that poultry farms are highly associated with high density of flies and high infectious diseases in this area [47].

The breeding places of the stable fly (*S. calcitrans*) were practically not found in livestock facilities. However, some individuals of this species were found in December and January in animals and the FI was 1-3 individuals. Since this species prefers manure mixed with vegetation and food residues for laying eggs, it can be assumed that some individuals on animals in winter are individuals of the autumn generation.

Due to a decrease in the number of grazed animals on pastures and a high density of house flies in summer camps and in livestock facilities, which has become a competitor in the development of larval stages to the field fly (*M. autumnalis*), at present (2019-2020) this species has decreased. The fly index (FI) in summer camps was 3-5 individuals, and in the premises 2-4 individuals on animals. Dung flies *Scatophaga stercoraria* have recently become the standard test organism for evaluating the toxic effects of veterinary drugs in livestock manure [41].

Tracking the movement of insects in their natural habitat is an important link in understanding their basic biology, demography and ethology [48]. To study the ecology of flies, they are tagged with special markers [49; 50]. Using this research method, it was found that after 5 days, on average, 60% of the tagged flies released into the poultry houses remained there, and 13% moved to dairy farms, and about 70% of the tagged flies released to dairy farms remained there after 5 days, while 10% moved to poultry houses [51]. In our studies, we also used luminiferous dyes of different colors, while the basic green dye (TAT 33) was more effective when treating flies for 5 days, compared to violet and blue dyes. Luminescences can be used in entomological studies to differentiate larval blowflies (or other dipterans) species or individuals [52].

As climate change progresses, the control program for parasitic dipterans must adapt [53]. A better understanding of the behavior of parasitic dipterans will help improve the effectiveness of fly control in the private and public sectors.

CONCLUSIONS

The prospect for further research is the development of innovative, environmentally friendly means to control and combat parasitic dipterans in animal husbandry.

Musca domestica (Linnaeus, 1758) was found in all livestock facilities for keeping animals and in poultry houses in eight regions of Ukraine. In pasture biotopes, two species of flies have been identified that do not attack animals, but are mineralisers of cattle feces – *Ortellia caesarion* Meigen (glittering dung fly) and *Ortellia cornicina* Fabr. (green dung fly). The largest number of house flies was noted in the premises for keeping sows with suckling pigs (312.0±35.3) and fattening animals (277.5±6.1). In cattle, the largest number of flies (258.3±83.4) was recorded in the premises for keeping calves. *M. domestica, M. autumnalis*, and *S. calcitrans* account for 75.57% of the entire complex of zoophilic flies. The species *M. vitripennis, M. tempestiva, L. irritans, H. atripalpis* also occupy an important place among the species that form the entomoparasitocenosis (18.91%).

Luminiferous marker L-1 basic green (TAT 33) fixes well on insects and lasts for 5 days. The density of the fly population in the pig houses is 36% higher than in the calf houses. During the research, the species composition of zoophilic flies and their distribution over biotopes in different livestock agroecosystems have been studied.

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Фауна і екологія двокрилих (Díptera, Muscidae) тваринницьких біоценозів України

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Анотація. Біологія та екологія паразитуючих комах тісно пов'язана з життєдіяльністю людей, і основне місце при цьому займає тваринництво. Негативний вплив паразитуючих двокрилих на продуктивних тварин важко переоцінити, особливо у сезон їх масового розмноження та поширення. Метою роботи було вивчити видовий склад двокрилих різних тваринницьких біоценозів східної та центральної України. Для вилову зоофільних мух використовували ентомологічні сачки та пастки, чисельність комах визначали за допомогою мушиного індексу, а також використовували люмінесцентні маркери ТАТ 33 з фракцією порошку 30 мікрон. Зібраних комах ідентифікували відповідно до існуючих сучасних визначників. В результаті проведених досліджень встановлено наявність *Musca domestica* (Linnaeus, 1758) у всіх тваринницьких приміщеннях з утриманням тварин та птиці. Найбільша чисельність кімнатної мухи відзначена у приміщеннях з утриманням свиноматок з підсосними поросятами (312,0±35,3) та тварин на відгодівлі (277,5±6,1). На частку *M. domestica*, *M. autumnalis* та *S. calcitrans* припадає 75,57 % від усього комплексу зоофільних мух. Види *M. vitripennis*, *M. tempestiva*, *L. irritans*, *H. atripalpis* також займають значне місце серед видів, що формують ентомопаразитоценоз (18,91 %). У пасовищних біотопах виявлено два види мух (*Ortellia caesarion* Meigen та *Ortellia cornicina* Fabr.), які не нападають на тварин, але є мінералізаторами фекалій великої рогатої худоби. Люмініфорний маркер Л-1 базовий зелений (ТАТ 33) добре фіксується на комах та утримується протягом 5 днів. Щільність популяції мух у приміщеннях з утримання свиней вище на 36 % порівняно з приміщеннями, де утримуються телята. Отримані результати є підставою для розробки інноваційних, науково-обґрунтованих схем контролю та боротьби з паразитуючими комахами на тваринницьких підприємствах

Ключові слова: зоофільні мухи, видовий склад, *Musca domestica*, чисельність популяції, агробіоценоз, люмінофор, маркування