

# Species Composition and Landscape-Zonal Distribution of Horseflies (Diptera, Tabanidae) in the Territory of Belgorod Province

Yu. A. Prisniy

*Belgorod National Research University, Belgorod, 308015 Russia*

*e-mail: prisniy\_y@bsu.edu.ru*

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**Abstract**—A list of 30 species of the family Tabanidae recorded in Belgorod Province is provided, and data on the landscape-zonal distribution, typical biotopes, and dates of flight in the region are given for each species. The greatest number of horsefly species (24) was recorded in the southern forest-steppe subzone, and smaller numbers, in the central forest-steppe subzone (18) and the steppe zone (16). Half of the forest and forest-steppe species extend into the steppe zone while some southern species penetrate into the forest-steppe zone. The pattern of horsefly distribution is determined by the biotopic conditions. The boundaries of distribution of individual species do not distinctly correspond to those of the landscape subzones.

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Horseflies are a group of dipterans of great medical and veterinary importance. They are annoying blood-suckers that cause great discomfort to man and cattle during summer. Some species transmit tularemia, anthrax, trypanosomiasis, and filariasis (Tarasov, 1996; Prudkina, 2011). Horseflies are characterized by considerable species diversity, which needs to be studied in order to take adequate measures of prevention of naturofocal diseases of man and domestic animals.

This communication summarizes the results of studies of horseflies which were carried out from 2002 to 2013 in Belgorod Province (BP). The province lies in the central part of the Russian Plain. Its territory (with a total area of 27 100 km<sup>2</sup>) provides a considerable diversity of environmental conditions changing from northwest to southeast. The greatest part of Belgorod Province lies in the southern forest-steppe subzone. Its northern part (Gubkin and Saryi Oskol Districts) is positioned in the central forest-steppe subzone, and its southeastern part (Rovenki, Valuiki, and Veidelevka Districts), in the steppe zone (Avramenko et al., 2007; Prisniy, 2005).

No special studies of the horsefly fauna have been carried out before in BP. As a result of 12 years of research, the presence of 30 species of horseflies in this territory was established or confirmed, which allowed me to analyze their biotopic associations and

landscape-zonal distribution. The results of this work are presented below.

## MATERIALS AND METHODS

Research was carried out in June–August 2002–2013, in 68 localities positioned in the territory of 18 of 21 administrative districts of Belgorod Province (table; figure). Horseflies were collected by the standard methods, including capture with the entomological net from a warm object (an automobile), and also Skufin dummy traps and “kerosene pools” (Skufin, 1973; Gaponov et al., 2009; Prudkina, 2011). In addition, I examined the collections of the Department of Ecology, Physiology and Biological Evolution of Belgorod National Research University, which contained 56 specimens of 19 species of horseflies captured in the 1970–1990s.

Horseflies were identified to species using the published reviews (Olsufiev, 1969, 1977; Boshko, 1973; Prudkina, 2011). Microscopical preparations of sternite VIII were made for identification of species of the genus *Hybomitra*. Some specimens (from collection sites 15, 16, 20, and 21; see table) were collected and identified by researchers from Voronezh State University (Budaeva et al., 2013). Altogether, about 800 horseflies were examined; 708 specimens, including 681 females and 27 males, were identified to species. The studied material is kept at the Department of

Ecology, Physiology and Biological Evolution of Belgorod National Research University.

*The History of Study and the Species List of Horseflies of Belgorod Province*

The review of Skufin (1998) summarized faunistic data on 38 horsefly species of the Central Chernozem Region of Russia. It contained references to the findings of one species (*Atylotus latistriatus*) in the eastern districts of BP and the possible presence there of 13 more species broadly distributed in the Central Chernozem Region.

As the result of my study of the fauna of terrestrial insects in the south of the Central Russian Upland, 19 horsefly species were recorded in the territory of BP (Prisniy, 2003).

Regular studies of the bloodsucking arthropods, including horseflies, of Belgorod Province started in 2002 (Prisniy, 2004, 2007, 2011; Budaeva et al., 2013).

Data on the number of the specimens collected, collection sites and biotopes, and the timing of flight are provided below for each horsefly species. Besides, the landscape and zonal preferences (Olsufiev, 1977) and the records in the adjoining Kharkov (KhP) (Prudkina and Pavlov, 2001) and Voronezh (VP) (Skufin, 1998; Panteleeva, 2005) Provinces are indicated for each species. To my knowledge, there are no publications on the horseflies of Kursk, Sumy, and Lugansk Provinces.

Subfamily **Chrysopsinae** Lutz, 1905

Genus **Chrysops** (C.) Mg., 1803

1. *C. caecutiens* (L., 1758), a forest species. Adjoining territories: KhP and VP. BP: central and southern forest-steppe. Material: 14 ♀, west (collection sites 1, 10), north (15, 16), center (25, 36, 46), and east (51) of BP. Biotopes: oakeries, deciduous forests, and also floodplain and calciphyte meadows. Flight: from July to the 1st decade of August.

2. *C. flavipes* Mg., 1804, a forest-steppe species. Adjoining territories: KhP and VP. BP: southern forest-steppe. Material: 1 ♀, center of BP (25). Time and biotope: July, an oakery edge.

3. *C. italicus* Mg., 1804. Adjoining territories: KhP. BP: southern forest-steppe and steppe. Material: 18 ♀, west (6, 11), center (23, 34, 35, 40, 41, 44, 46), east

(54), and southeast (63, 65) of BP. Biotopes: river banks and floodplains, oakery edges, and wet meadows. Flight: from the 2nd decade of June to the 1st decade of August.

4. *C. parallelogrammus* Zeller, 1842, a forest-steppe species. Adjoining territories: no data. BP: southern forest-steppe. Material: 1 ♀, center of BP (47). Time and biotope: July, an oakery edge.

5. *C. relictus* Mg., 1820, a forest-steppe species. Adjoining territories: KhP and VP. BP: southern forest-steppe and steppe. Material: 35 ♀, center (25, 26, 28, 34, 35), east (48, 49, 52) and southeast (57, 65) of BP. Biotopes: oakery edges, wet and calciphyte meadows. Flight: from the beginning of June to the 1st decade of August.

6. *C. rufipes* Mg., 1820, a forest-steppe species. Adjoining territories: KhP and VP. BP: southern forest-steppe. Material: 3 ♀, west of BP (6). Time and biotope: July, a floodplain.

7. *C. viduatus* (Fabricius, 1794), a forest species. Adjoining territories: KhP and VP. BP: central and southern forest-steppe, steppe. Material: 54 ♀, west (3, 4, 5, 11, 12), north (15, 16, 18, 19, 20), center (25, 28, 33, 34, 35, 39, 40, 42, 43, 44, 46), east (53, 54, 55), and southeast (58, 64) of BP. Biotopes: edges of oakeries and deciduous forests; also occurs in steppified and wet meadows. Flight: from the beginning of June to the 2nd decade of August.

Subfamily **Pangoniinae** Rondani, 1856

Genus **Pangonius** (P.) Latreille, 1802

8. *Pangonius pyritosus* Loew, 1859, a steppe species. Adjoining territories: KhP (Olsufiev, 1977). BP: southern forest-steppe. Material: 1 ♀, west of BP (13). Time and biotope: July, a steppified meadow.

Subfamily **Tabaninae** (Latreille, 1802) Loew, 1860

Genus **Haematopota** Mg., 1803

9. *H. pallens* Loew, 1871, a desert species<sup>1</sup>. Adjoining territories: VP. BP: steppe. Material: 1 ♀, southeast of BP (68). Time and biotope: August, a floodplain meadow.

<sup>1</sup> Here and below, the term "desert species" is used in the sense "a species belonging to the desert faunistic complex" (see Olsufiev, 1977).

**Table 1.** Collection sites of horseflies (Tabanidae) in Belgorod Province

No.	Locality	Biotope	Latitude north*	Longitude east*
I. West and northwest of BP, central forest-steppe and western part of southern forest-steppe				
1	Kozinka; right bank of the Vorskla, Zemnoi Rai area	oakery	50°28'00"	35°34'10"
2	Gora-Podol; edge of Mokhovatoe bog	sphagnum bog	50°29'30"	35°37'00"
3	Pochaevo; Kuchukovo area	deciduous forest	50°38'45"	35°35'45"
4	Kosilovo	oakery	50°39'10"	35°37'45"
5	Dragunka	mixed forest, ravine, mesophytic meadow	51°01'00"	35°59'00"
6	Peschanoe; floodplains of the Psel	alder forests	51°08'50"	36°01'20"
7	Pokrovka	bank of pond	50°36'15"	35°48'50"
8	Nikolskii; left bank of the Vorskla	mesophytic meadow	50°34'34"	35°51'30"
9	Khotmyzhsk; Krasivo area	pine forest	50°34'23"	35°52'36"
10	Dubino; left bank of the Vorskla	mixed forest, edge of sphagnum bog	50°36'23"	35°57'10"
11	Belogorye State Reserve, Les na Vorskle area	tall oakery	50°37'16"	35°57'00"
12	Malye Kulbaki vacation home compound	deciduous forest	50°39'50"	36°20'10"
13	Volkhov; ravine slope	mesoxerophytic meadow	50°38'00"	36°21'30"
14	Yakovlevo	deciduous forest, ravine	50°52'18"	36°24'51"
15	Melavoe	deciduous forest	51°08'20"	37°22'40"
16	Dalnaya Livenka	deciduous forest	51°06'06"	37°29'40"
17	Belogorye State Reserve, Lysye Gory area	oakery	51°14'05"	37°28'20"
18	Sergievka	oakery	51°12'25"	37°30'30"
19	Sergievka	mesoxerophytic meadow	51°13'15"	37°33'00"
20	Belogorye State Reserve, Yamskaya Step area	mesophytic meadow	51°11'20"	37°37'10"
21	Belogorye State Reserve, Yamskaya Step area	forb steppe	51°11'20"	37°37'45"
22	Kotenevka; Dolgoe area	oakery	51°11'00"	37°44'00"
II. Central part of BP, southern forest-steppe				
23	Komsomolets	oakery, ravine	50°33'00"	36°25'26"
24	Oskochnoe	oakery, clearing	50°38'20"	36°33'00"
25	Belgorod; Monastyrskii Les area	oakery	50°38'39"	36°36'31"
26	Belgorod; right bank of the Vezelka	mesophytic meadow	50°35'28"	36°34'00"
27	Belgorod; Sosnovka area	pine forest	50°33'00"	36°37'00"
28	Vergelevka	oakery, ravine	50°19'25"	36°35'00"
29	Voroshilovka; right bank of the Korocho	mesohydrophytic meadow, pasture	50°44'10"	37°08'50"
30	Korocho; right bank of the Korocho	edge of alder forest	50°49'20"	37°12'20"
31	Pavlovka	ravine, mesoxerophytic meadow	50°47'30"	37°25'40"
32	Yablonovo–Pavlovka	ravine, mesoxerophytic meadow	50°49'50"	37°25'10"
33	Khmelevoe	mesophytic meadow	50°52'00"	37°25'35"
34	Khmelevoe; ravine	mesoxerophytic meadow	50°53'00"	37°27'50"
35	Olshanka	mesophytic meadow, pasture	51°00'00"	37°43'00"
36	Chernyanka; right bank of the Oskol	upland oakery with pines	50°54'50"	37°46'00"
37	Lubyanoe Pervoe	ravine slope, mesoxerophytic meadow	50°55'50"	38°14'20"
38	Arkhangelskoe; Korovinskaya Dacha area	oakery	50°22'25"	36°47'10"
39	Krapivnoe; right bank of the Koren	upland oakery	50°26'40"	36°52'45"

Table 1. (Contd.)

No.	Locality	Biotope	Latitude north*	Longitude east*
40	Malomikhailovka; Bekaryukovskii Bor area, cut-off meander of the Nezhegol	pine forest	50°26'20"	37°04'20"
41	Bolshetroitskoe–Maksimovka; right bank of the Nezhegol	oakery	50°32'10"	37°20'10"
42	Artelnoe; right bank of the Nezhegol	oakery	50°35'50"	37°17'36"
43	Belomestnoe; right bank of the Oskol	chalk outcrops, mesoxerophytic meadow	50°40'20"	37°44'00"
44	Belogorye State Reserve, Stenki-Izgorya area	upland oakery	50°40'40"	37°48'30"
45	Nechaevka	oakery	50°44'55"	37°57'00"
46	Makeshkin; left bank of the Oskol	mesophytic meadow	50°38'23"	37°48'05"
47	Zhilin; right bank of the Oskol	upland oakery	50°36'30"	37°46'14"
III. East and southeast of BP, eastern part of southern forest-steppe and steppe				
48	Tishanka, right bank of the Volchya	mesoxerophytic meadow	50°24'20"	37°30'00"
49	Yutanovka; right bank of the Oskol	mesophytic meadow, oakery	50°29'00"	37°48'50"
50	Veseloe	chalk outcrops, mesoxerophytic meadow	50°37'55"	38°06'45"
51	Novokhutornoe	chalk outcrops, mesoxerophytic meadow	50°33'40"	38°11'00"
52	Svistovka; ravine slope	mesoxerophytic meadow	50°59'40"	38°44'30"
53	Svistovka	deciduous forest	50°59'20"	38°47'00"
54	Svistovka	bank of pond	51°01'20"	38°47'25"
55	Afonasevka–Podserednee	ravine, mesophytic meadow	50°44'05"	38°35'00"
56	Varvarovka	ravine oakery	50°22'16"	38°53'16"
57	Konoplyanovka; right bank of the Oskol	ravine, oakery	50°19'00"	37°51'00"
58	Yablonovo, Lisy Gora protected natural area	upland oakery, mesophytic meadow	50°13'20"	38°00'40"
59	Novye Melnitsy; right bank of the Oskol	oakery	50°02'46"	37°56'50"
60	Dubrovki; right bank of the Oskol	ravine, mesophytic meadow	50°03'30"	38°00'00"
61	Viktoropol; Gniloe area	ravine forest	50°04'17"	38°31'31"
62	Viktoropol; Kamenya area	feathergrass steppe	50°03'30"	38°32'00"
63	Rovenki; Rovenskii Yar area	deciduous forest	49°54'45"	38°51'30"
64	Rovenki; left bank of the Aidar	mesophytic meadow	49°54'20"	38°53'20"
65	Nagolnoe; right bank of the Sarma	mesophytic meadow	49°58'40"	38°57'30"
66	Klimenkovo; right bank of the Sarma	mesoxerophytic meadow	49°59'30"	39°02'55"
67	Vsesvyatka; right bank of the Sarma	mesophytic meadow	50°01'30"	39°06'00"
68	Nizhnyaya Serebryanka; left bank of the Aidar	mesophytic meadow	49°49'15"	38°55'45"

\* Coordinates of localities were determined using Google Earth.

10. *H. pluvialis* (L., 1758), a forest species. Adjoining territories: KhP and VP. BP: central and southern forest-steppe. Material: 85 ♀, west (4, 5, 6, 9, 10, 11, 14), north (15, 16, 20, 21), center (23, 25, 27, 30, 33, 35, 38, 40, 42, 44), and east (48, 49, 53) of BP. Biotopes: oakeries, deciduous, mixed, and pine forests; also occurs in wet meadows. Flight: from the 3rd decade of May to the 2nd decade of August.

11. *H. subcylindrica* Pandellé, 1883, a forest-steppe species. Adjoining territories: KhP and VP. BP: central forest-steppe. Material: 2 ♀, north of BP (15). Time and biotope: July, an edge of a deciduous forest.

#### Genus *Atylotus* Osten-Sacken, 1876

12. *A. fulvus* (Mg., 1804), a forest species. Adjoining territories: KhP and VP. BP: central and southern forest-steppe. Material: 21 ♀, west (12, 13), north

**Table 2.** The number of collection sites of horsefly species in different landscape zones and subzones and in sectors distinguished within Belgorod Province

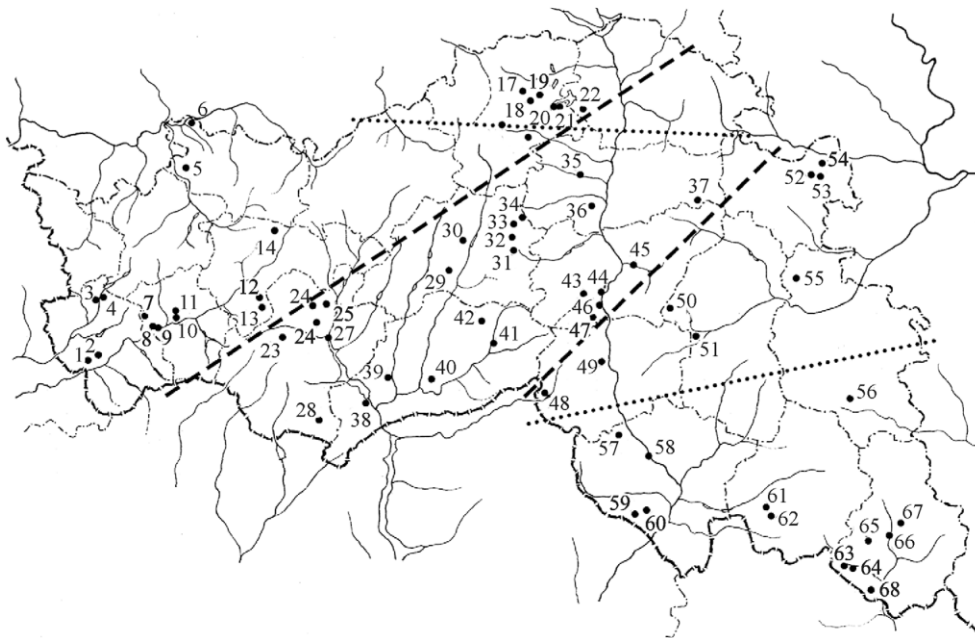
No.	Species	Central forest-steppe (15–22)	Southern forest-steppe			Steppe (southeast) (56–68)
			West (1–14)	Center (23–47)	East (48–55)	
1	<i>Chrysops caecutiens</i> (L., 1758)	2	2	3	1	
2	<i>C. flavipes</i> Mg., 1804			1		
3	<i>C. italicus</i> Mg., 1804		2	7	1	2
4	<i>C. parallelogrammus</i> Zeller, 1842			1		
5	<i>C. relictus</i> Mg., 1820			5	3	2
6	<i>C. rufipes</i> Mg., 1820		1			
7	<i>C. viduatus</i> (Fabricius, 1794)	5	5	11	3	2
8	<i>Pangonius pyritosus</i> Loew, 1859		1			
9	<i>Haematopota pallens</i> Loew, 1871					1
10	<i>H. pluvialis</i> (L., 1758)	4	7	10	3	
11	<i>H. subcylindrica</i> Pandellé, 1883	1				
12	<i>Atylotus fulvus</i> (Mg., 1804)	1	2	5		
13	<i>A. latistriatus</i> Brauer, 1880	1		5	2	1
14	<i>A. rusticus</i> (L., 1767)	6	1	6	5	2
15	<i>Hybomitra bimaculata</i> (Macquart, 1826)	2	4	6		
16	<i>H. ciureai</i> (Séguy, 1937)	4	4	3	1	1
17	<i>H. distinguenda</i> (Verrall, 1909)	3	2	2		
18	<i>H. expollicata</i> (Pandellé, 1883)			1		
19	<i>H. muehlfeldi</i> (Brauer, 1880)	2	4	2		2
20	<i>H. nitidifrons</i> (Szilády, 1914)	2	3	1		
21	<i>H. peculiaris</i> (Szilády, 1914)					1
22	<i>H. ukrainica</i> (Olsufjev, 1952)					1
23	<i>Tabanus autumnalis</i> L., 1761	2	1	2		1
24	<i>T. bovinus</i> L., 1758	3	1	6		1
25	<i>T. bomius</i> L., 1758	3	2	5	4	1
26	<i>T. glaucopis</i> Mg., 1820				1	
27	<i>T. maculicornis</i> Zetterstedt, 1842	1				
28	<i>T. miki</i> Brauer, 1880	1	1	2	2	1
29	<i>T. sudeticus</i> Zeller, 1842	3	5	6		1
30	<i>T. unifasciatus</i> Loew, 1858		1	1	1	1

(18), and center (25, 29, 32, 45, 46) of BP. Biotopes: mostly oakery edges and floodplain meadows. Flight: from the end of June to the beginning of August.

13. *A. latistriatus* Brauer, 1880, a steppe species. Adjoining territories: no data. BP: central and southern forest-steppe, steppe. Material: 11 ♀, north (17), center (31, 33, 43, 44, 45), east (52, 55), and southeast (62) of BP. Biotopes: oakery edges, wet and calciphyte

meadows, and steppe areas. Flight: from the 3rd decade of June to the 1st decade of August.

14. *A. rusticus* (L., 1767), a forest-steppe species. Adjoining territories: KhP and VP. BP: central and southern forest-steppe, steppe. Material: 154 ♀ and 21 ♂, west (5), north (15, 16, 18, 19, 20, 21), center (25, 33, 35, 37, 38, 44), east (48, 53, 54, 55, 60), and southeast (57, 65) of BP. Biotopes: edges of oakeries, deciduous, and mixed forests, and also wet meadows.



Collection sites of horseflies (Tabanidae) in Belgorod Province. For designations, see Table 1.

Flight: from the beginning of June to the 2nd decade of August.

#### Genus *Hybomitra* Enderlein, 1922

15. *H. bimaculata* (Macquart, 1826), a taiga-forest species. Adjoining territories: KhP and VP. BP: central and southern forest-steppe. Material: 38 ♀, west (5, 11, 12, 14), north (15, 20), and center (25, 35, 38, 39, 42, 44) of BP. Biotopes: oakeries and deciduous forests. Flight: from the beginning of June to the 1st decade of August.

16. *H. ciureai* (Séguy, 1937), a forest-steppe species. Adjoining territories: KhP and VP. BP: central and southern forest-steppe, steppe. Material: 49 ♀, west (1, 4, 5, 12), north (15, 16, 20, 21), center (25, 33, 44), east (49), and southeast (58) of BP. Biotopes: oakeries and deciduous forests; also occurs in wet meadows. Flight: from the 3rd decade of May to the 2nd decade of August.

17. *H. distinguenda* (Verrall, 1909), a forest species. Adjoining territories: VP. BP: central and southern forest-steppe. Material: 29 ♀, west (2, 4), north (15, 18, 20), and center (25, 42) of BP. Biotopes: oakeries. Flight: from the beginning of June to the 2nd decade of August.

18. *H. expollicata* (Pandellé, 1883), a steppe species. Adjoining territories: VP. BP: southern forest-steppe. Material: 1 ♀, center of BP (25). Time and biotope: July, an oakery edge.

19. *H. muehlfeldi* (Brauer, 1880), a taiga-forest species. Adjoining territories: VP. BP: central and southern forest-steppe, steppe. Material: 30 ♀, west (2, 5, 9, 12), north (20, 21), center (42, 44), and southeast (58, 59) of BP. Biotopes: oakeries and pine forests with sphagnum bogs. Flight: from the beginning of June to the 2nd decade of August.

20. *H. nitidifrons* (Szilády, 1914), a taiga-forest species. Adjoining territories: VP. BP: central and southern forest-steppe. Material: 15 ♀, west (8, 14), north (15, 16, 20), and center (25) of BP. Biotopes: deciduous forests, oakeries. Flight: from the 2nd decade of May to the 2nd decade of August.

21. *H. peculiaris* (Szilády, 1914), a desert species. Adjoining territories: no data. BP: steppe. Material: 1 ♀, southeast of BP (68). Time and biotope: July, a floodplain meadow.

22. *H. ukrainica* (Olsufjev, 1952), a steppe species. Adjoining territories: KhP. BP: steppe. Material: 1 ♀, southeast of BP (66). Time and biotope: July, a calci-phyte meadow.

#### Genus *Tabanus* L., 1758

23. *T. autumnalis* L., 1761, a forest-steppe species. Adjoining territories: KhP and VP. BP: central and southern forest-steppe. Material: 10 ♀, west (12), north (18, 21), and center (24, 25) of BP. Biotopes: oakeries. Flight: from the 2nd decade of June to the 1st decade of August.

24. *T. bovinus* L., 1758, a forest species. Adjoining territories: KhP and VP. BP: central and southern forest-steppe, steppe. Material: 23 ♀ and 1 ♂, west (3), north (16, 20, 21), center (23, 26, 28, 35, 38, 39), and southeast (59) of BP. Biotopes: edges of oakeries and deciduous forests, and also wet meadows. Flight: from the beginning of June to the 1st decade of August.

25. *T. bromius* L., 1758, a forest-steppe species. Adjoining territories: KhP and VP. BP: central and southern forest-steppe, steppe. Material: 24 ♀, west (4, 12), north (15, 16, 21), center (25, 28, 33, 38, 39), east (48, 49, 54, 56), and southeast (58) of BP. Biotopes: edges of oakeries and deciduous forests, and also wet and calciphyte meadows. Flight: from the 2nd decade of June to the 2nd decade of August.

26. *T. glaucopsis* Mg., 1820, a forest species. Adjoining territories: VP. BP: southern forest-steppe. Material: 1 ♀, east of BP (52). Time and biotope: July, a steppe plot.

27. *T. maculicornis* Zetterstedt, 1842, a forest species. Adjoining territories: KhP and VP. BP: central forest-steppe. Material: 1 ♀, north of BP (16). Time and biotope: July, an edge of a deciduous forest.

28. *T. miki* Brauer, 1880, a forest species. Adjoining territories: KhP and VP. BP: central and southern forest-steppe, steppe. Material: 10 ♀, west (7), north (15), center (33, 35), east (53, 55), and southeast (59) of BP. Biotopes: edges of deciduous forests, wet meadows. Flight: from the beginning of June to the 1st decade of August.

29. *T. sudeticus* Zeller, 1842, a forest species. Adjoining territories: KhP and VP. BP: central and southern forest-steppe, steppe. Material: 39 ♀ and 5 ♂, west (1, 2, 4, 5, 10), north (15, 16, 22), center (25, 26, 38, 39, 42, 44), and southeast (61) of BP. Biotopes: oakeries and deciduous forests; also occurs in mixed forests with sphagnum bogs. Flight: from the 2nd decade of June to the 2nd decade of August.

30. *T. unifasciatus* Loew, 1858, a forest species. Adjoining territories: no data. BP: central and southern forest-steppe, steppe. Material: 5 ♀, west (3), center (25), east (50), and southeast (67) of BP. Biotopes: edges of oakeries and deciduous forests, and also wet and calciphyte meadows. Flight: from the beginning of June to the 1st decade of August.

places of their development while seeking and actively pursuing their hosts. Horseflies require open, well-heated territories with boggy or waterlogged soils. Of the climate factors, horseflies are directly affected by the temperatures of the air, the water in reservoirs, and the soil, as well as by the amount of precipitation, the length of the frost-free season, and the possibility of cold spells in early summer and early fall. The development, dispersal, and mass reproduction of horseflies are favored by the landscape types characterized by the presence of orographic depressions, rich, warm, and sufficiently moist soils, well-heated reservoirs, eutrophic lakes, transitional and lowland bogs, and abundant vegetation and invertebrate fauna in stagnant and flowing waters. The possibilities of horsefly development are limited or totally absent in the places where the above set of factors is incomplete (Lutta, 1970).

In view of the specific traits of horsefly biology, the following physiographic, landscape-zonal, and biotopic conditions of BP should be noted.

BP is positioned on the southwest and south slopes of the Central Russian Upland, at altitudes of 100–300 m above sea level. The terrain is an undulating plain dissected by a network of gullies and ravines as well as river valleys (Avramenko et al., 2007) in which many horsefly species develop.

Despite the fact that BP lies within two landscape zones, the steppe and forest-steppe, the latter being subdivided into the southern and central forest-steppe subzones, its environmental conditions primarily change not from north to south but from northwest to southeast. The annual number of days with the mean daily air temperature above 10°C increases in this direction from 156 to 164 and greater values; the effective heat sum for the period with stable temperatures exceeding 10°C increases from 2500 to 2700°C and more (Grigoriev and Stepina, 2005a, 2005b); correspondingly, the hydrothermal index for the period with air temperatures above 10°C decreases from 1.2 to 0.9 and less (Grigoriev et al., 2005). Considering the overlapping boundaries of hydrological regions and the values of the hydrothermal index, the mean daily air temperature, and the effective heat sum, and also taking into account the natural territorial complexes, Belgorod Province can be subdivided into three sectors (“west-northwest,” “central,” and “east-southeast”) more adequately reflecting the gradation of conditions affecting the faunistic complex of horseflies on the south macroslope of the Central Russian Upland.

## DISCUSSION

Horseflies are the largest insects of the complex of bloodsucking dipterans. They can fly far from the

### *The West-Northwest Sector*

This sector comprises the western part of the southern forest-steppe subzone and the central forest-steppe subzone. Its territory is characterized by the densest river network (0.20–0.25 km/km<sup>2</sup>), but the rivers are narrow and carry little water. The climate of the sector is the coolest and the most leveled. The mean temperature of January is –7.5°C, that of July is +19.0°C. The annual amount of precipitation is the greatest for BP: 575–600 mm (Chendev, 1996). The vegetation is characterized by insular distribution of broadleaved forests and oakeries among the open areas that are almost completely tilled. The forest cover has the highest values of 11–14% in the western part, decreases to 8–11% in the northwestern direction, and reaches only 5% in the northern districts (Zinoviev, 2005).

The biotopes of horseflies are represented there by mesophytic, less frequently mesoxerophytic meadows on the slopes of ravines, and also oakeries, mesohygrophytic meadows in the river floodplains, and bogs.

The fauna of horseflies of this territory counts 22 species. They mostly develop in the moist soils on the banks of reservoirs and bogs, wet meadows, and forest edges; an insignificant fraction of species develops in open reservoirs.

### *The Central Sector*

This sector occupies almost half of the BP territory including the greater (central) portion of the southern forest-steppe subzone. The river network density is 0.20–0.35 km/km<sup>2</sup>. Most rivers are shallow, with beds only several meters wide, but there are also large rivers: Severski Donets and Oskol. The climate parameters of the sector are the most typical of BP. The mean temperature of January is –8.0°C, that of July is +19.5°C. The annual precipitation is 550–570 mm (Chendev, 1996). The center of the province has an almost uniform forest cover of 8–11% (Zinoviev, 2005).

The biotopes of horseflies are represented there by mesophytic and mesoxerophytic meadows, meadow steppes with participation of calciphilous species and feathergrass, oakeries, pine forests, and mesohygrophytic meadows in the river floodplains.

The fauna of horseflies of this territory counts 22 species. They mostly develop in the moist soils on the banks of reservoirs and in swamped depressions, less frequently in wet meadows and forest edges; an insignificant fraction develops in open reservoirs.

### *The East-Southeast Sector*

This sector includes a small eastern part of the southern forest-steppe subzone and the steppe zone. The river network density does not exceed 0.15 km/km<sup>2</sup>. The rivers are not large but their floodplains are strongly swamped in some places. The climate is more continental as compared to the western districts. The mean temperature of January is –8°C, that of July is +20–21°C. The annual precipitation is 500–520 mm, the greatest part of it being the summer showers (Chendev, 1996). Forests occupy no more than 8% of the area (Zinoviev, 2005).

The biotopes of horseflies are represented there by mesophytic and mesoxerophytic meadows with admixture of calciphytes and feathergrass, small ravine oakeries, pine forests, and also mesohygrophytic, sometimes swamped meadows in the river floodplains.

The fauna of horseflies of this territory counts 18 species. They mostly develop in the moist soils on the banks of reservoirs, swamped floodplains, and forest edges; an insignificant fraction develops in open reservoirs.

Thus, among the 30 horsefly species found in BP, the fraction of forest species is the largest, including 13 species; there are 8 forest-steppe species and 9 steppe ones. Adult horseflies occur in the territory of BP in 13 types of biotopes, of which the highest diversity is typical of edges of oakeries (22 species) and deciduous forests (19), and also mesophytic (15) and mesoxerophytic meadows (19). Hemihydrobionts and edaphobionts prevail among the species complexes of the three sectors of BP while the fraction of hydrobionts is small. Correspondingly, the places of development of the horsefly larvae are similar within the entire province: these are mostly banks of reservoirs, wet meadows, and forest edges.

The highest species diversity of horseflies in Belgorod Province was observed in the forest-steppe zone: 26 species (18 in the southern forest-steppe subzone and 24 in the central forest-steppe subzone); 16 species were recorded in the steppe zone. Nearly half of the forest and forest-steppe species partly extend into the steppe zone while some southern species extend into the forest steppe zone but do not enter the central forest-steppe subzone (with the exception of *A. latistriatus*). The fractions of forest and forest-steppe species decrease from 67 to 37% and from 28 to 25%, respectively, while the fraction of steppe



species increases from 5 to 37% from north to south, i.e., from the central forest-steppe to the steppe.

The faunas of the west-northwest, central, and east-southeast sectors distinguished in the territory of BP contain 22, 22, and 18 horsefly species, respectively. The fraction of forest species decreases from 55 to 44% from northwest to southeast, that of forest-steppe species decreases from 27 to 22% in the same direction, while that of steppe species increases from 20 to 33%.

These figures confirm the dependence of the ecological diversity of horseflies on the diversity of landscape and ecological conditions, and also demonstrate the diffuse nature of the boundaries of landscape zones in the studied region.

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