

# Biodiversity of Coleoptera (Insecta) in Lipetsk Region (Russia)

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**Abstract:** (1) Background: Coleoptera is one of the most diverse insect lineages. Coleoptera species live in many ecosystems around the globe and their role in ecosystems is very diverse. To study the number and distribution of species, lists of species were compiled and then added into the database generation platforms. The aim of the work was to describe the modern fauna of Coleoptera based on a recently published dataset. (2) Methods: Studies were conducted from 1971 to 2022. Insects were collected by different means (searching under the bark of trees and stumps, sifting litter and wood dust, soil samples, caught in the light, in soil traps, window traps, etc.). For each observation, the coordinates of the place of discovery, the number of individuals, dates were noted. (3) Results: The dataset presents data on 2416 species and subspecies of Coleoptera from 89 families found in the Lipetsk region. In total, the number of studied specimens in the dataset was 16,184, the number of occurrences was 6192. The largest families in terms of species diversity were Staphylinidae (541 species), Curculionidae (416), Chrysomelidae (315) and Carabidae (285). (4) Conclusions: In addition, based on the analysis of additional references, 452 more species and 2 families are indicated. Thus, the biodiversity of Coleoptera of the Lipetsk region is 2868 species from 89 families.

**Keywords:** species diversity; beetles; comparison of fauna; dataset; Center of European Russia



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## 1. Summary

Coleoptera is one of the most diverse insect orders in the world, which dominates many ecosystems in terms of individual abundance and occupied niches [1]. The order Coleoptera plays an important role in the development of organic matter, pollination of angiosperms, biotic interactions in communities, in the formation of soil cover [2–7]. However, in recent years, there has been a decrease in the number and species diversity of many insect groups, including Coleoptera [8,9]. The massive decline in insect diversity and biomass in human-dominated ecosystems is often associated with habitat loss (e.g., agricultural intensification), landscape fragmentation, chemical pollution, climate change, destructive fires, the introduction and increase in the number of invasive species, as well as a combination of these factors [10–16].

To understand how the number and biodiversity of insects change and the relative importance of various threats in the development of these trends, it is necessary to go beyond the results of individual studies and systematically summarize the available data on insects [17–20]. However, to understand the changes taking place on a global scale, it is important to know local and regional faunas. Most faunal studies focus on systematically or methodologically limited groups of insects [19,21]. However, there is an urgent need to document and understand nature at a speed that will provide us with an informed systemic response to the accelerating impact that humans have on the world [22]. For documentation, there are various platforms for creating databases that can be accessed by all users [17,23]. Such platforms provide the largest collections of species occurrence records. The data on these platforms have served as the basis for numerous analyses and

assessments of biodiversity, but also revealed clear distortions, gaps and heterogeneity of quality, and therefore they should be handled carefully to cope with these problems [19,24].

P.P. Melgunov started studying Coleoptera of the Lipetsk region. He visited this region from 1871 to 1881 and collected barbel beetles from there. Subsequently, the main entomological works were associated with the creation of the Galichya Gora Nature Reserve in 1925 [25,26]. However, the most significant number of publications about the Coleoptera of the Lipetsk region appeared from the 1990s to the present. M.N. Tsurikov [27,28] summed up the general biodiversity of the Coleoptera fauna of the Lipetsk region. At that time, the known regional biodiversity was 2288 species of Coleoptera. However, further intensification of entomological research allowed us to find other Coleoptera species in the Lipetsk region. The purpose of this work is to describe the modern fauna of Coleoptera based on a recently published dataset [29].

## 2. Data Description

### 2.1. Data Set Name

In the dataset, each observation includes basic information: location (latitude/longitude), date of observation, the name of the observer and the name of the identifier. The coordinates were determined on the spot using a GPS device or after research using Google Maps (Table 1).

**Table 1.** Description of the data in the dataset.

Column Label	Column Description
occurrenceID	An identifier for the Occurrence (as opposed to a particular digital record of the occurrence).
basisOfRecord	The specific nature of the data record: HumanObservation
scientificName	The full scientific name including the genus name and the lowest level of taxonomic rank with the authority
kingdom	The full scientific name of the kingdom in which the taxon is classified
decimalLatitude	The geographic latitude of location in decimal degrees
decimalLongitude	The geographic longitude of location in decimal degrees
geodeticDatum	The ellipsoid, geodetic datum, or spatial reference system (SRS) upon which the geographic coordinates given in decimalLatitude and decimalLongitude is based.
country	The name of the country in which the Location occurs
countryCode	The standard code for the country in which the Location occurs.
individualCount	The number of individuals represented present at the time of the Occurrence.
eventDate	The date when material from the trap was collected or the range of dates during which the trap collected material
year	The integer year in which the Event occurred.
month	The ordinal month in which the Event occurred.
day	The integer day of the month on which the Event occurred
recordedBy	A person, group, or organization responsible for recording the original Occurrence.
identifiedBy	A list of names of people, who assigned the Taxon to the subject

### 2.2. Figures, Tables and Schemes

The dataset presents data on 2416 species and subspecies of Coleoptera from 89 families found in the Lipetsk region and documented simultaneously with the coordinates (Table 2). The total number of occurrences was 6192, the number of studied specimens was 16,184. The largest families in terms of species diversity were Staphylinidae (including Silphinae) (541 species), Curculionidae (416), Chrysomelidae (315) and Carabidae (285).

**Table 2.** Species diversity of beetles of the Lipetsk region.

Family	Number of Species (Our Data)	Number of Species (Literary Data *)
Sphaeriidae	0	1
Gyrinidae	5	6
Halplidae	8	8
Noteridae	2	2
Dytiscidae	77	81
Carabidae	253	285
Scirtidae	8	9
Clambidae	1	2
Eucinetidae	1	1
Dascillidae	0	1
Byrrhidae	6	8
Buprestidae	43	51
Dryopidae	3	4
Elmidae	1	2
Heteroceridae	5	5
Throscidae	3	3
Eucnemidae	4	5
Lycidae	3	4
Cantharidae	26	32
Elateridae	42	52
Drilidae	1	1
Lampyridae	1	1
Histeridae	35	49
Georissidae	1	1
Helophoridae	9	11
Hydrochidae	5	5
Spercheidae	1	1
Hydrophilidae	46	54
Ptiliidae	7	22
Hydraenidae	8	9
Leiodidae	22	32
Staphylinidae	407	541
Trogidae	4	4
Lucanidae	3	3
Bolboceratidae	1	1
Geotrupidae	2	3
Ochodaeidae	1	1
Scarabaeidae	69	84
Dermestidae	20	23
Bostrichidae	5	5
Ptinidae	21	31
Byturidae	2	2
Biphylidae	1	1
Cleridae	8	9
Trogossitidae	3	4
Melyridae	17	21
Lymexylidae	1	1
Mordellidae	14	21
Scaptiidae	7	10
Aderidae	5	5
Oedemeridae	12	12
Boridae	1	1
Pythidae	1	1
Salpingidae	2	6
Pyrochroidae	1	1
Meloidae	7	15
Anthicidae	13	15
Melandryidae	9	10

Table 2. Cont.

Family	Number of Species (Our Data)	Number of Species (Literary Data *)
Zopheridae	3	4
Ciidae	16	16
Tetratomidae	1	1
Mycetophagidae	11	11
Tenebrionidae	50	54
Bothrideridae	1	1
Cerylonidae	2	3
Latridiidae	25	33
Corylophidae	5	7
Endomychidae	6	7
Coccinellidae	52	52
Erotylidae	10	11
Sphindidae	1	2
Monotomidae	12	12
Kateretidae	8	8
Nitidulidae	65	70
Cryptophagidae	35	38
Cucujidae	2	2
Silvanidae	6	7
Phalacridae	11	15
Laemophloeidae	6	9
Megalopodidae	1	1
Orsodacnidae	1	2
Cerambycidae	82	92
Chrysomelidae	297	315
Cimberididae	2	2
Nemonychidae	1	1
Anthribidae	8	10
Attelabidae	14	18
Brentidae	64	71
Curculionidae	354	416
<b>Total</b>	<b>2416</b>	<b>2868</b>

\*—literary data [27,30–37].

However, it was impossible to accurately document and give geographical coordinates for some species. This was due to the inaccuracy of the data from the labels of the places of finds, incorrect location indication and other reasons. However, such finds of many species do not cause any doubts on the accuracy of the definition and their habitat in the territory of the Lipetsk region. Therefore, Table 2 provides additional information from various literature data.

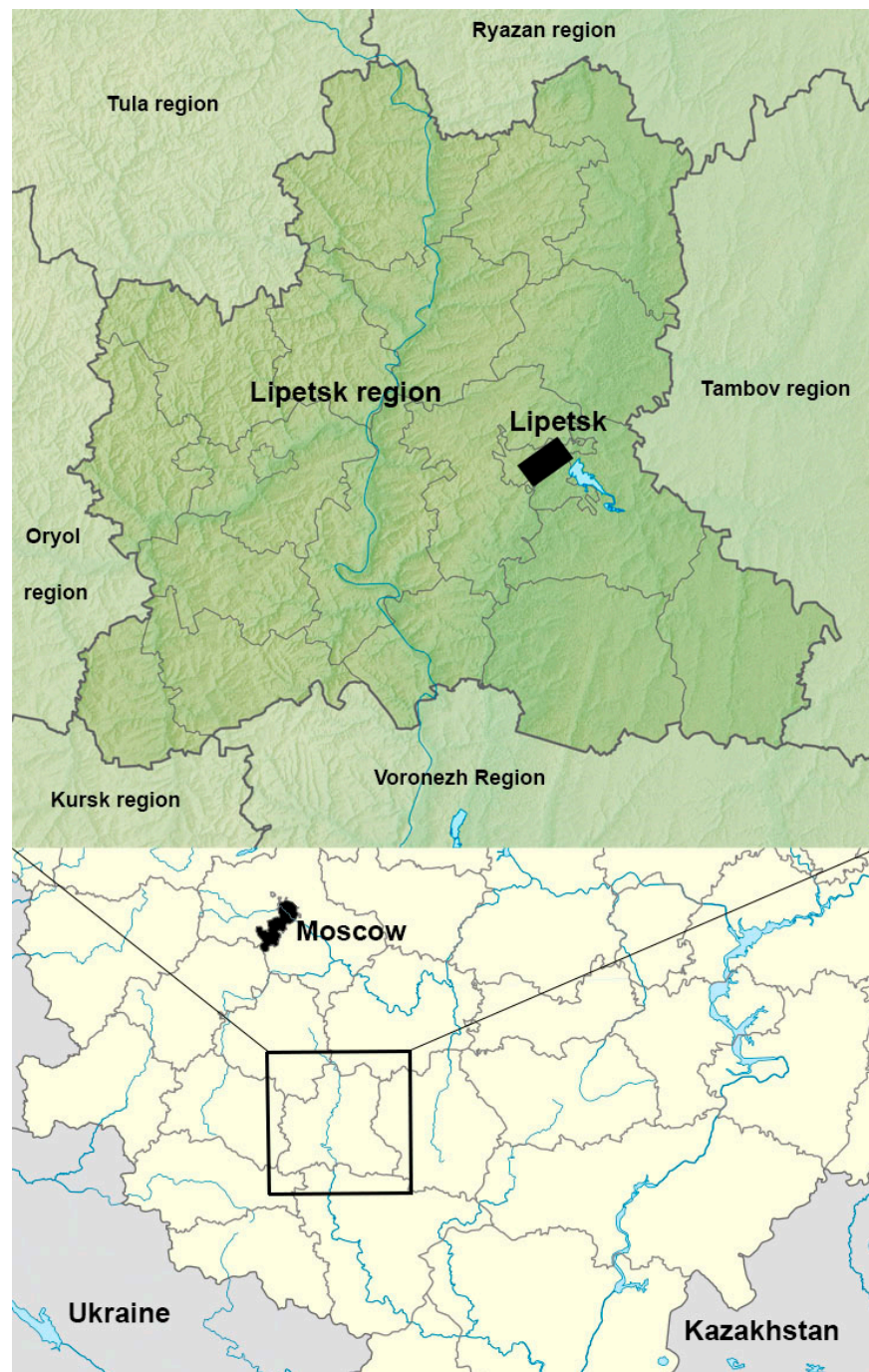
Thus, the total species diversity of Coleoptera of the Lipetsk region was 2868 species from 89 families. To compare this data with the species diversity of Coleoptera in some regions of the European part of Russia: Moscow region—4010 [38], Ulyanovsk region—more than 3000 species [39], Chuvash Republic—about 3000 species [40], Udmurt Republic—more than 2400 species [41], Samara region—1844 species [42], 1827 species in the Voronezh region [43]. Significant differences in the biodiversity of Coleoptera of separate regions are associated with different problems. The richest in terms of the number of species are regions that have been studied by specialists using a variety of methods for many decades.

In the territory of the Lipetsk region, there are six species that are listed in the Red Book of Russia. *Dytiscus latissimus* lives in rivers, ponds, lakes. The frequency of occurrence of the species in the region is low. *Calosoma sycophanta* is very rare and not caught every year. It is detected at single instances. *Carabus hungaricus* was discovered once in 1948 in the Zadonsk district [27]. *Lucanus cervus* has been recorded in the oak forests of the Gryazi and Usman districts; however, this information requires confirmation by modern studies [31]. The range of *Protaetia fieberi* includes the Lipetsk region. However, there is no reliable information about the findings of this species yet [44]. *Protaetia speciosissima* is

periodically caught in some areas of the Lipetsk region. The frequency of the occurrence of the species in the region is low.

### 3. Methods

The Lipetsk region is located in the central part of the East European Plain within two Central Russian Uplands (covering 75.2% of the territory) and the Oka-Don Plain (24.8%). The border between them runs along the valleys of the Voronezh River and the Stanovaya Ryasa River (Figure 1).



**Figure 1.** Map of the Lipetsk region.

The Central Russian upland is an undulating plain with absolute marks of 210–260 m with river valleys, gullies, ravines. The slopes of the valleys here often drop off steeply



to floodplains and in riverbeds, forming high limestone cliffs. The interfluvium of the Don and Voronezh has slightly elevated plains. Ravines have developed on the slopes of river valleys and gullies, landslides occur. Karst processes take an important place. The climate of the region is moderately continental with warm summers and comparatively cold winters. The continentality of the climate increases from the north-west to the south-east, summer temperatures increase in the same direction along with a decrease in average relative humidity. The average temperature for the year is +5.2 °C. The warm period on average begins in early April and ends about 6–10 November. A characteristic feature of the spring period is an extremely rapid rise in temperature. An average of 660 mm/year of precipitation falls on the territory of the region. The region belongs to the zone of insufficient humidification, and signs of an arid climate are often recorded [45].

Chernozems dominate in the soil cover of the Lipetsk region. The main types of vegetation consist of oak forests and meadow steppes. Some extrazonal and intrazonal elements of vegetation influence the vegetation cover in a specific way. Its active spread deep into the region is facilitated by the directions of rivers: pine forests penetrate from the north along the valley of Voronezh, and elements of southern typical steppes penetrate from the south along the valleys of Olym, Don and Voronezh. The intrazonal types of vegetation in the region include meadows, sphagnum swamps, floodplain vegetation, vegetation of reservoirs, rock groupings, fragments of a halophilic complex. Along with the dominant oak forests (30% of the total forest area), there are elm, aspen, birch, alder, poplar and pine forests. The Lipetsk region is one of the most economically developed in Russia (81.2% of the area is occupied by agricultural land) [46].

The material for the work was Coleoptera collections on the territory of the Lipetsk region mainly over the last 50 years (1971–2022). All samples were collected mainly by V.T. Kuznetsova (1965–1997), N.Yu. Panteleeva (1976–1988), M.N. Tsurikov (1995–2017), S.G. Mazurov (since 2006), Ya.A. Urbanus (since 2000), A.A. Prokin (since 1998), D.I. Pereverzev (2000–2008). All reliable published information from the territory of the Lipetsk region is also summarized. The main part of the samples is kept in the collection of the state reserve “Galichya Gora”, as well as in the personal collections of A.A. Prokin, Ya.A. Urbanus, S.G. Mazurov. Parts of the collections were transferred to a number of scientific centers of Russia and the Czech Republic.

In the course of the research, traditional and diverse methods were used: manual collection, searching under the bark of trees and stumps, sifting litter and dust in the spring, soil samples, the use of air, migration and soil traps, light fishing, catching flying individuals, mowing with an entomological net, splashing and trampling on the shores of reservoirs, collecting in rotting substrates, in places of shelters and wintering, etc. [47]. The research was carried out in all districts of the region, about 300 geographical locations were surveyed.

The classification of the family-group taxa used predominantly follows Cai et al. [48] and McKenna et al. [49]. The lists of species were verified according to the Catalogue of Palaearctic Coleoptera [50–58], to Robertson et al. [59], and to Alonso-Zarazaga et al. [60]. The years of description of some beetle species are specified according to Bousquet [61].

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