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RESEARCH ARTICLE

A dataset on the distribution of genus *Panorpa* (Mecoptera, Panorpidae) in the forest and forest-steppe zones of European Russia

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Abstract

Among all insects, the order Mecoptera is the least studied in European Russia. Among this order, the small family Panorpidae stands out, the species of which are found mainly in forest ecosystems. In order to fill this gap, during 2008, 2009, 2011, 2015, and 2017-2023 we collected data for the Panorpa distribution dataset in European Russia. In our research, the biology of 6 species of *Panorpa* (*P. alpina*, *P. cognata*, *P. communis*, *P. germanica*, *P. hybrida*, *P. vulgaris*) was studied. To obtain the most information, various collection methods were used (handheld sweep-net, light traps, pitfall traps, pan traps, Malaise traps, and window traps) and the entire insect activity season. Data have been obtained that can be used to understand the timing of species activity in nature, to understand biotopic preference, and to study other aspects of *Panorpa* biology.

Keywords
Panorpa, forest, forest-steppe, European Russia, distribution, dataset, GBIF

Introduction

In terms of species diversity, abundance, and ecological influence, insects stand unparalleled among multicellular organisms on our planet. In terrestrial ecosystems, insects establish intricate connections with numerous other organisms, spanning from pollination to predation (Forister et al. 2019). Regrettably, recent years have witnessed a concerning decline in the number, taxonomic richness, and geographical distribution of insects globally, prompting fears of potential extinction for 40% of the world's insect species within the forthcoming decades (Sánchez-Bayo and Wyckhuys 2019; Wilson and Fox 2020; Hill et al. 2021) Several factors contributing to the decline in insect populations have been identified, with habitat loss and climate change being foremost among them in temperate zones (Sánchez-Bayo and Wyckhuys 2019; Ruchin et al. 2019; Dedyukhin 2022; Karban and Huntzinger 2021; Zouaimia et al. 2022; Ananyev et al. 2023; Vorobjeva and Chertoprud 2023; Dedyukhin 2023). It is noteworthy that instances of population decline often stem from geographically restricted studies in specific regions (Montgomery et al. 2020; Yang et al. 2021).

Consequently, there is a pressing need to investigate insect distribution across regional faunas, conduct comprehensive species inventories, and explore understudied taxonomic groups (Montgomery et al. 2020). Given its expansive territory and the pristine condition of many ecosystems, Russia plays a crucial role in conserving numerous Palearctic species, including insects (Govorushko and Nowicki 2019). Nevertheless, within such vast expanses, numerous insect species remain undiscovered, and various facets of the life activities of specific taxonomic groups remain insufficiently studied (Krivosheina and Ozerov 2021; Ruchin et al. 2021; Storozhenko 2021; Sundukov and Makarov 2021).

The genus *Mecoptera* represents an insect group with insufficiently documented biology in the European part of Russia. Notably, the family Panorpidae, accounting for approximately 500 described species primarily distributed across the Northern Hemisphere (Wang and Hua 2021), stands out within this order. Adults exhibit a diverse dietary spectrum, ranging from decaying animal and plant substrates to deceased insects, with certain species displaying phytophagous tendencies (Byers and Thornhill 1983; Palmer 2010; Huang and Hua 2011). The larvae of Panorpidae primarily engage in saprophagous feeding habits, targeting decomposed arthropods (Engels and Sauer 2007; Cai and Hua 2009; Jiang and Hua 2015). Larvae, usually an eruciform and edaphic form, occur in the soil or on the ground (Byers 1997).

Panorpidae species frequently serve as model organisms for the investigation of insect mating behavior. Males in many species exhibit a proclivity to present salivary secretions or prey items to females as a mating gift (Engqvist 2009; Tong and

Hua 2019). Within the European part of Russia, six Panorpidae species are documented (Dvořák et al. 2023, 2024).

Materials and methods

Data collection

The research spans multiple years, encompassing the periods of 2008, 2009, 2011, 2015, and 2017–2023. Methods adhered to conventional practices, employing hand-held sweep-nets, light traps, pitfall traps, pan traps, Malaise traps, and window traps (Golub et al. 2012).

Light traps were a construction of a screen, a lamp and a bottom grid. The screen was made of white cloth. The lamps were used in various capacities – from 125 to 400 watts. These were lamps with a spectrum of light, both with a predominance of blue and a predominance of red light spectrum. Light traps were installed in places where there are electric power sources, as well as generators. Usually such light traps worked all night.

Pitfall traps were 0.5 l plastic cups. They were installed in the soil at the level of the hole. For preservation, a 4% formalin solution or acetic acid was used, which was poured in a volume of 150 ml. Such traps were installed in different biotopes in one line for 10 traps in each line. The distance between the traps varied from 1.5 to 2 m. Usually one such line stood (exposure time) for 10-28 days.

Pan traps were yellow plastic plates with a diameter of 20 cm and a volume of 1 liter, filled with 2/3 water with the addition of detergent. Usually, 7 to 10 traps were used, which were placed in a line in grassy vegetation or in the open ground. The distance between the plates varied from 1 to 3 m. The exposure time ranged from 3 to 7 days. Such traps have been used in forest biotopes and in open ecosystems.

As window traps, we used traps made of transparent plastic according to the design described earlier (Cavaletto et al. 2021). We used one such trap in one biotope. The trap was suspended by a rope from a tree branch. The traps were placed on tree branches at a height of 1.5 to 2 m from the soil surface and were placed in forest ecosystems.

A white homemade trap was used as Malaise traps. The basis for its manufacture was Malaise traps in the style of Townes (Townes 1972). The frame for the trap was made of wooden posts. The insect collection tanks were filled with 70% ethanol. For greater efficiency, the trap was installed on the edges of forests or slightly in the depths of woodlands. The exposure time ranged from 3 to 12 days.

Beer traps were made from plastic 1.5-liter or 5-liter containers. On one side of the bottle, an insect window was cut into them. Such traps were located on tree branches at a height of 1.5 to 12 m from the soil surface. Fermenting beer with an addition in the form of honey, jam or sugar was used as bait. Beer traps were set on the edges of forests, along the edge of clearings, inside woodlands. The exposure time of beer traps ranged from 3 to 12 days (Ruchin et al. 2020). The number of species used to collect insects is shown in Fig. 1.

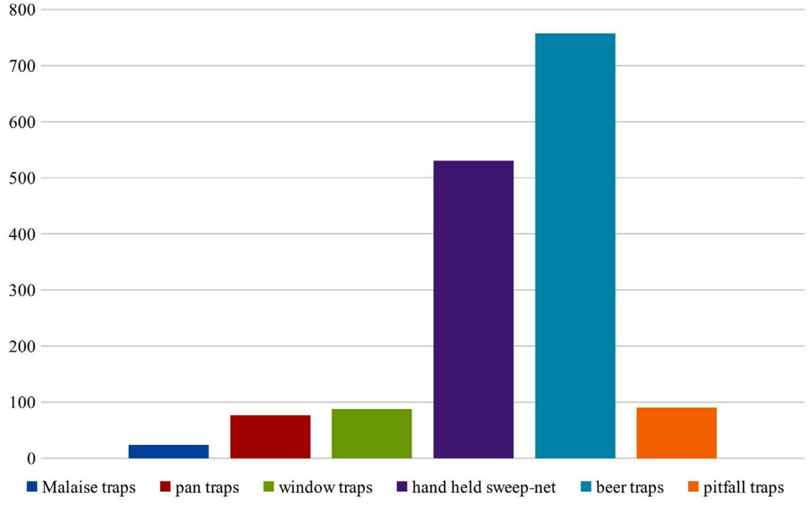

Figure 1. The number of insect collection methods used to obtain information for the dataset.

All the above methods of collecting insects were used in different months of the greatest activity (in European Russia it is from April to October). Adult Panorpidae are usually more active in the summer months, however, we captured some specimens in April, May and autumn (Fig. 2).

Study area

The research material was collected from the eastern and partially central regions of the East European Plain. Characterized by undulating terrain with elevations ranging from 200 to 300 m above sea level, the plain also encompasses lowlands traversed by major rivers, notably the Volga and Don. The average elevation of the plain stands at approximately 171 m, with the highest point, reaching 479 m, located on the Bugulminsko-Belebeevskaya upland in the Urals. Geographically located within the temperate continental belt, except for the Far North, the East European Plain experiences a climate marked by certain distinct features. Continental influence intensifies eastward, and the plain is subject to the inflow of air masses and cyclones from the Atlantic, resulting in substantial precipitation. Simultaneously, unhindered penetration of Arctic air masses from the north contributes to temperature drops and frosts during spring and autumn. Polar masses originating from the northeast and tropical air from the south also influence the plain, leading to droughts and dry winds in its southern and central regions. The distinctive zonality of landscapes characterizes the nature of the plain. The Far North houses the tundra zone, while south of the Arctic Circle, forest tundras emerge. In the middle zone of the Russian plain, forest landscapes prevail, transitioning from dark coniferous taiga in the north to mixed and deciduous forests in the south. Further southward, these forests give way to forest-steppes and steppes, characterized by fertile predominantly chernozem soils and herbaceous vegetation (Sidorchuk et al. 2001; Klimenko and Solomina 2010.

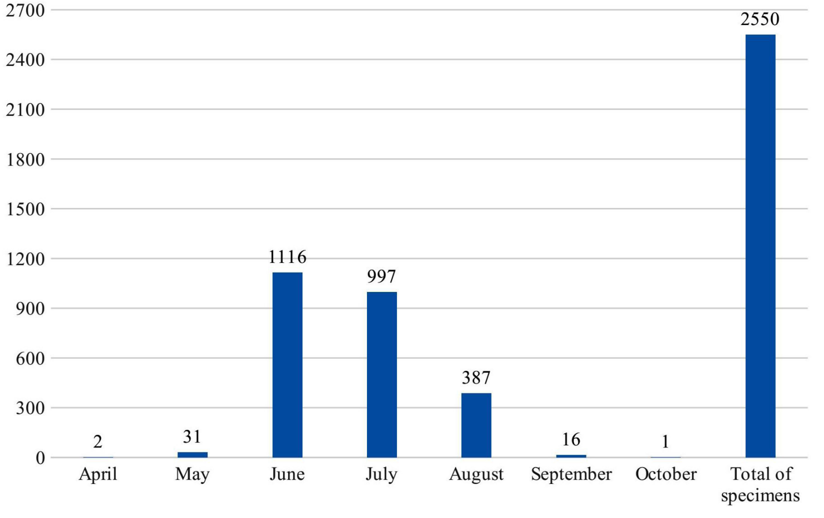

Figure 2. The number of specimens of Panorpidae by months of collection in ecosystems that were indicated in the dataset.

The samples were identified by morphological features specified in various manuals (Guide of insects … 1987). In almost all cases, the samples were fixed in alcohol or ethyl acetate. In case of identification difficulties, an analysis of the genitals was performed. The most of the material was identified by L. Dvořák, voucher specimen are deposited in his private collection.

Data from the dataset can be uploaded as a single XLSX file to GBIF (https://www.gbif.org/dataset/c72e82bc-3453-4dda-9ce3-b51ea3c0d8bd) (Dvořák et al. 2024). It contains 920 rows, and each row represents a set of data. The columns contained in it are as follows (Table 1):

Table 1. Pyraloidea, collected in the Pulyaevka village of Belgorod Region

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.

Column label	Column description
kingdom	The full scientific name of the kingdom in which the taxon is classified.
phylum	The full scientific name of the phylum or division in which the taxon is classified.
class	The full scientific name of the class in which the taxon is classified.
order	The full scientific name of the order in which the taxon is classified.
family	The full scientific name of the family in which the taxon is classified.
decimalLatitude	The geographic latitude of location in decimal degree.
decimalLongitude	The geographic longitude of location in decimal degrees.
coordinateUncertaintyInMeters	The horizontal distance (in meters) from the given decimalLatitude and decimal-Longitude describing the smallest circle containing the whole of the Location.
geodeticDatum	The ellipsoid, geodetic datum, or spatial reference system (SRS) upon which the geographic coordinates given in decimalLatitude and decimalLongitude as based.
country	The name of the country in which the Location occurs. Here – Russia.
countryCode	The standard code for the country in which the Location occurs. Here – RU.
individualCount	The number of individuals represented present at the time of the Occurrence.
samplingProtocol	The methods or protocols used during collecting specimens.
eventDate	The date when material from the trap was collected or the range of dates during which the trap collected material.
year	The integer day of the month on 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.

Results

Description of dataset

Taxonomic ranks

Kingdom Animalia
Phylum Arthropoda
Subphylum Hexapoda
Class Insecta
Order Mecoptera

Family Panorpidae
Genera *Panorpa*
Species *Panorpa alpina*, *Panorpa cognata*, *Panorpa communis*, *Panorpa germanica*, *Panorpa hybrida*, *Panorpa vulgaris*

In the course of our research, we studied a total of 2,250 specimens representing six species of the genus *Panorpa* (*Panorpa alpina* Rambur, 1842, *Panorpa cognata* Rambur, 1842, *Panorpa communis* Linnaeus, 1758, *Panorpa germanica* Linnaeus, 1758, *Panorpa hybrida* MacLachlan, 1882, *Panorpa vulgaris* Imhoff & Labram, 1845) (Fig. 3). *P. communis* demonstrated the highest abundance – 1253 specimens, followed by *P. vulgaris*, for a fraction of which there are 844 copies. In contrast, *P. alpina* (17 specimens) and *P. germanica* (16 specimens) are represented in the smallest numbers.

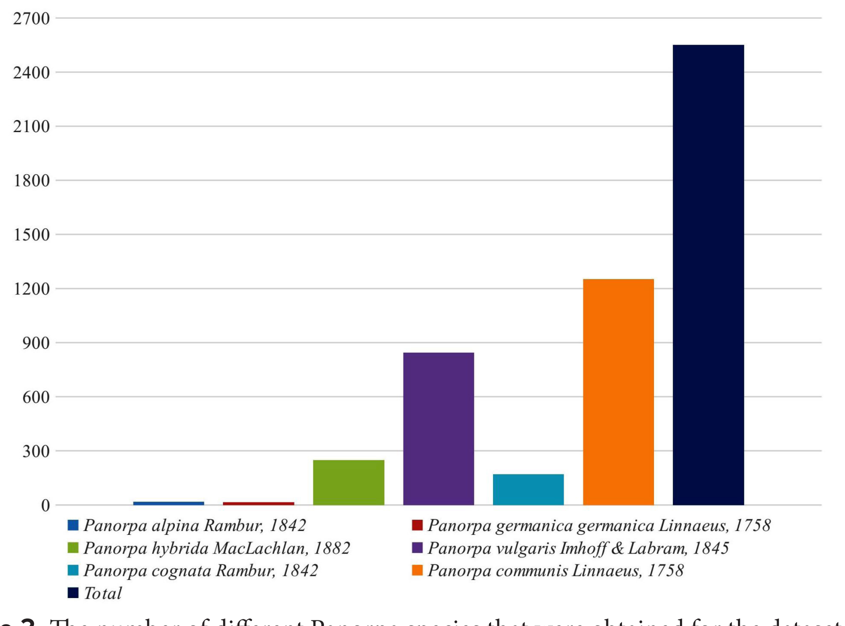

Figure 3. The number of different Panorpa species that were obtained for the dataset.

A total of 920 occurrences are indicated in the dataset. The largest number of occurrences was typical for *P. communis*. The smallest number became known for *P. germanica* and *P. alpina* (Fig. 4).

The collection of material was a collaborative effort, conducted by the authors themselves and sourced from colleagues across 16 regions of Russia (Kaluga Region, Orel Region, Moscow Region, Lipetsk Region, Voronezh Region, Tambov Region, Ryazan Region, Vladimir Region, Nizhny Novgorod Region, Republic of Mordovia, Penza Region, Chuvash Republic, Ulyanovsk Region, Republic of Tatarstan, Republic of Bashkortostan, Samara Region) (Figs 5, 6). The total area of the study is 738,000 km^2.

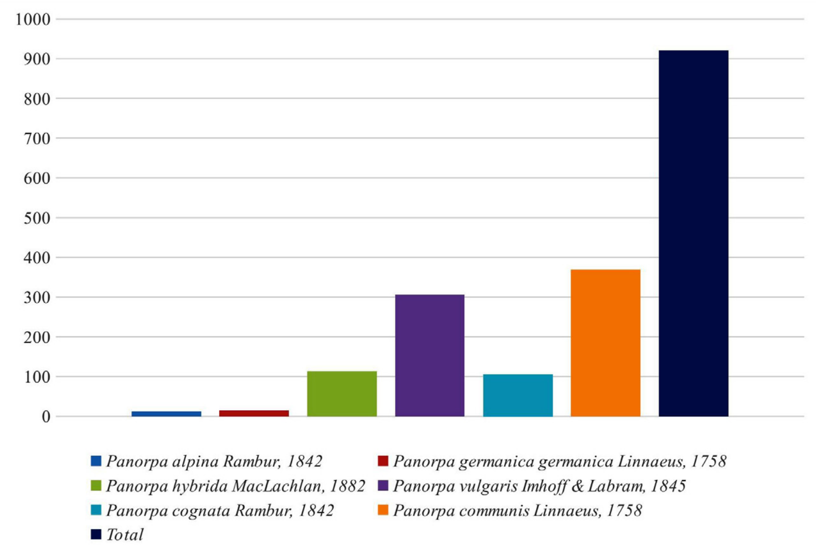

Figure 4. Occurrences of various *Panorpa* species that were obtained for the dataset.

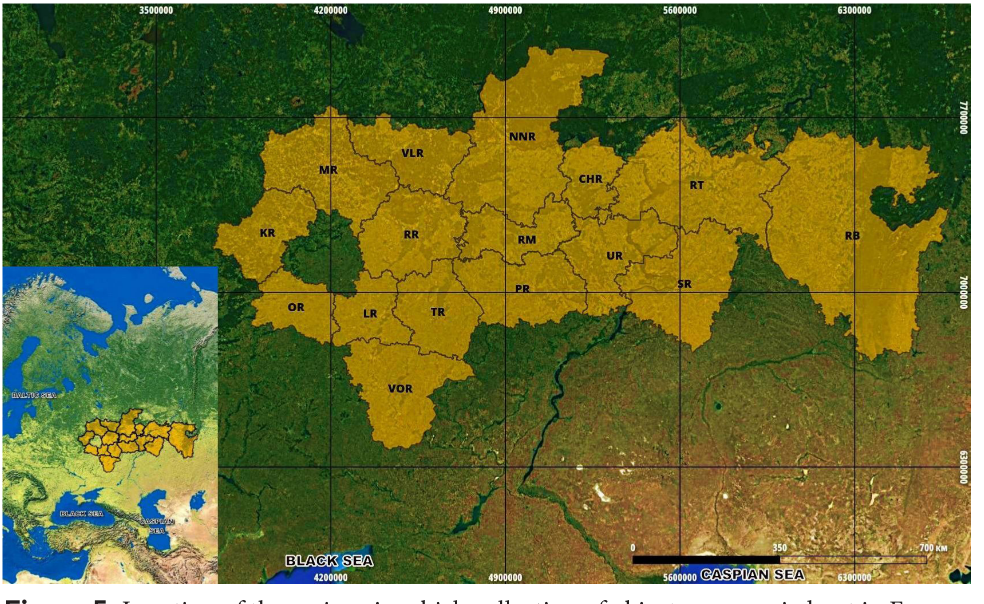

Figure 5. Location of the regions in which collection of objects was carried out in Europe. (KR – Kaluga Region, OR – Orel Region, MR – Moscow Region, LR – Lipetsk Region, VOR – Voronezh Region, TR – Tambov Region, RR – Ryazan Region, VLR – Vladimir Region, NNR – Nizhny Novgorod Region, RM – Republic of Mordovia, PR – Penza Region, CHR – Chuvash Republic, UR – Ulyanovsk Region, RT – Republic of Tatarstan, RB – Republic of Bashkortostan, SR – Samara Region).

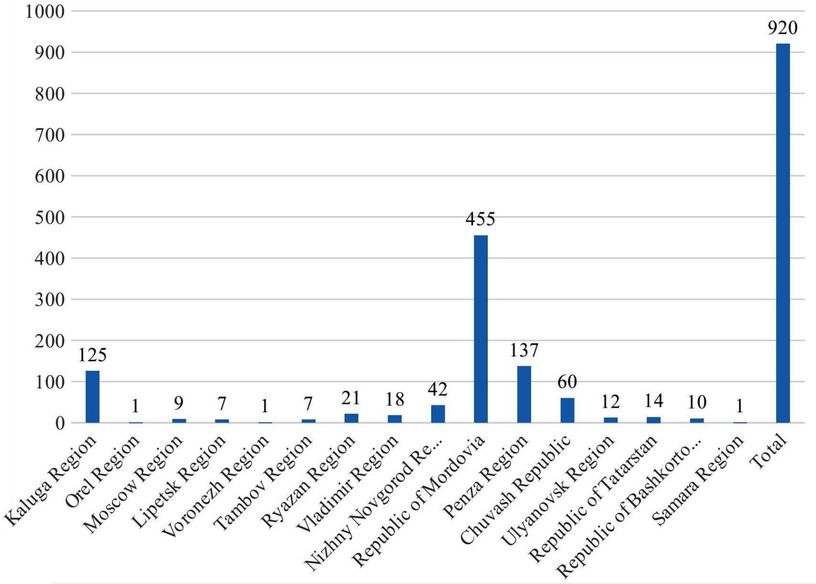

Figure 6. The number of localities in different regions from which information for the dataset was obtained.

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