Ground beetles (Carabidae) in urban habitats of Kaluga City (Russia)

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Abstract

Background

Ground beetles (Carabidae, Coleoptera) are one of the most species-rich and well-studied insect families. However, the number of published datasets is disproportionately low against the biodiversity of this group. According to GBIF, only a fifth of the percentage of all published data covers ground beetles. This article describes a sampling-event dataset providing primary data on ground beetles collected in urban and suburban habitats in Kaluga, a typical central Russian city. We surveyed habitats of different land-use types and the extent and intensity of anthropogenic influence: yards, gardens, quarries, small urban woodlands, grasslands and riparian habitats. Carabids were collected by pitfall traps during most of the vegetative season (mostly from late April - early May to at least early October) for 13 seasons between 1994 and 2015. In total, the dataset contains 189 carabid species and 79,091 specimens. The dataset provides information about species composition and abundance, habitat distribution, seasonal and long-term dynamics of carabid beetles in environments of different degrees of urbanisation.
New information

This dataset is the first sampling-event dataset about carabids in various urban habitats published through GBIF.

Keywords

broadleaved forests, gardens, grasslands, pitfall traps, Central Russia

Introduction

Ground beetles (Coleoptera, Carabidae) are a particularly popular model group of organisms for many kinds of ecological and environmental research, including studies of urbanisation (e.g. Klausnitzer and Richter 1983, Weller and Ganzhorn 2004, Magura et al. 2008, Niemelä and Kotze 2009, Schuett et al. 2018). The number of such papers has rapidly increased since the early 2000s (Magura and Lövei 2020). However, the results of these studies show inconsistent patterns of the effects of urbanisation on carabids. Generally, ground beetle assemblages in urban areas are species-poor, but sometimes researchers find high species richness and some rare species in urban and suburban habitats (Eversham et al. 1996, Zolotarev and Belskaya 2015, Belskaya et al. 2019). For Russian urban areas, there is quite a large array of carabid surveys (e.g. Dorofeev 1995, Sharova and Kiselev 1999, Eremejeva and Efimov 2006, Semenova 2008, Aleksanov et al. 2010, Zolotarev and Belskaya 2015, Aleksanov et al. 2019, Belskaya et al. 2019). However, the assessment of species diversity for different cities is rather complicated due to variation in sampling design in terms of sample plot sets and sampling methods. Typically ten traps per plot are often used to survey urban forests and parks (Niemelä et al. 2002, Semenova 2008, Niemelä and Kotze 2009), but sometimes eight (Weller and Ganzhorn 2004) or five (Deichsel 2006) traps were exposed. In urban grasslands, researchers have used six traps (Hartley et al. 2007) or have not mentioned trap numbers at all (Sharova and Kiselev 1999, Eremejeva and Efimov 2006). To understand patterns of formation of ground beetle assemblages in urban areas, we definitely need primary data. However, the above-cited Russian urban studies of carabids did not publish these. For Russia, a series of datasets on ground beetles from habitats of relatively low disturbance were published recently (Konakova and Kolesnikova 2018, Alekseev et al. 2021, Makarov and Sundukov 2021, Sundukov and Makarov 2021, Zinovyev et al. 2021). Most of them are located in Nature Reserves and National Parks. A considerable dataset was published for broadleaved forests of Kaluga Oblast, including Kaluga Urban Okrug (Shashkov et al. 2020a, Shashkov et al. 2020b). The dataset presented here complements the above-cited datasets with information from highly transformed habitats of this region.

Kaluga is a typical Central Russian town, amongst which there are both provincial centres such as Tver, Vladimir or Tula and municipalities - Serpukhov, Kolomna or others. Such a city usually occupies areas ranging from dozens to just over 150 km² and hosts populations of 100 to 400 thousand people. The centuries-old history and location, usually
on a large river (Oka or Volga, for example), result in an irregular planning and complex development history of such cities. The city centres usually formed between more than three and two hundred years ago, often spontaneously. Multi-storey housing can be surrounded by quarters of private householding with gardens and orchards. Wastelands with dense wild grass are usual, on the periphery of industrial zones, adjacent to railroads or even amongst high buildings, as a consequence of abandoned former Soviet projects. A large watercourse with its tributaries forms a complex mosaic of near-water habitats.

**Sampling methods**

**Study extent:** Kaluga City is situated in the west of European Russia, in its middle (non-Chernozem) zone on the Oka River 150 kilometres (93 mi) southwest of Moscow. The climate is moderately continental with distinct seasons: warm and humid summers and cold winters with stable snow cover. According to nearest (~ 70 km SW) weather station, for which open data are available - Suhinichi (RSM00027707), the average annual air temperature during years of investigation (1994-2015) was 5.8°C. The average temperature in July was +19.1°C and in January, −6.9°C. Annual precipitation was about 633 millimetres (Bulygina et al. 2014). The city is situated on the southern edge of a mixed broadleaved-coniferous forests subzone or continental biogeographical region (Anonymous 2016), on the north margin of the Central Russian Upland. The area of the City is 168.8 km$^2$ and the population is about 330 thousand people.

Prevailing landscapes of Kaluga City are flat, with undulating moraine plains shaped by the Moscow stage of the Dnieper glaciation. The main type of sediments is postglacial mantle-loams. Watersheds are flat and poorly drained. The minimal height above sea level is 116-120 m and the highest point reaches 235 m a.s.l. Along the Oka River, there is a highly-dissected erosional plain.

Regarding vegetation zonation, the area belongs to the subzone of spruce-broadleaved forests, a spruce-oak vegetation district (Pashkang 1992). As for the typical central Russian provincial centre, the urban landscapes of Kaluga City have developed more or less smoothly since the 16th century. The planning structures of Kaluga City were generally established during the last half of 18th and the first half of the 19th century. The modern city area has a striped pattern of residential and industrial buildings and agricultural lands because historically residential areas were planned near factories and other industrial objects. We distinguished three positions in the urban landscapes: city centre, city periphery and suburban zone. Locations of sample plots are mapped in Fig. 1. A brief characteristic of the sites is given in Table 1, including information on how the sample plots relate to city positions.
### Table 1.
Brief description of the sites (sample plots) sampled during a period between 1994 and 2015. A brief explanation of the habitat types is given above.

*Size of the open, unbuilt and undivided by roads, the area around sample plots facilitating dispersal of the ground beetles. This area can include various habitats, for example, woods, grasslands, gardens and others. Some plots are adjacent to each other so the open area around these has one and the same size.

** We define no areas which were larger than 1 km² and belong to suburb landscapes or are aligned along rivers.

| Type of habitat, land form | Coordinates (Latitude, Longitude) | Position in the city structure | Vegetation and land use (optional) | Size of unbuilt area around the plot, ha | Sampling period | Traps number | Plot ID (parent event) |
|---------------------------|-----------------------------------|-------------------------------|-----------------------------------|----------------------------------------|----------------|--------------|-----------------------|
| Forest, watershed slope   | 54.5056 36.2469                   | city centre                   | Park. Old lime trees (*Tilia cordata*) with grassy lawns | 15.5 | 20/04/1994 01/10/1994 | 30 | 94-Park |
|                           |                                   |                               |                                   |                                        | 20/04/1997 01/10/1997 | 30 | 97-Park |
| Forest, main river valley, S slope | 54.5061 36.2436 | city centre | Wood. Tree very dense layers dominated by box-elder (*Acer negundo*) and maple (*Acer platanoides*) with ruderal weeds | 15.5 | 18/05/2003 27/09/2003 | 15 | 03-Park |
| Forest, gully             | 54.5083 36.2447                   | city centre                   | Deciduous wood dominated by box-elder (*Acer negundo*) and maple (*Acer platanoides*) with ruderal weeds | 14.97 | 20/04/1994 01/10/1994 | 30 | 94-Ber |
|                           |                                   |                               |                                   |                                        | 20/04/1997 01/10/1997 | 30 | 97-Ber |
| Forest, gully, bottom     | 54.5092 36.2458                   | city centre                   | Deciduous wood dominated by box-elder (*Acer negundo*) and maple (*Acer platanoides*) with ruderal weeds | 14.97 | 03/05/2003-27/09/2003 | 15 | 03-Ber |
| Forest, gully, E slope    | 54.5093 36.2455                   | city centre                   | Deciduous wood dominated by lime (*Tilia cordata*), box-elder (*Acer negundo*), and maple (*Acer platanoides*) | 14.97 | 2004-05-02 2004-10-24 | 15 | 04-Ber |
| Forest, gully, E slope    | 54.5069 36.2678                   | city centre                   | Wood dominated by box-elder (*Acer negundo*) and maple (*Acer platanoides*) with ruderal weeds | 7.39 | 20/04/1994 01/10/1994 | 30 | 94-Zh |
|                           |                                   |                               |                                   |                                        | 20/04/1995 01/10/1995 | 30 | 95-Zh |
| Type of habitat, land form | Coordinates (Latitude, Longitude) | Position in the city structure | Vegetation and land use (optional) | Size of unbuilt area around the plot, ha | Sampling period | Traps number | Plot ID (parent event) |
|---------------------------|----------------------------------|-------------------------------|-----------------------------------|----------------------------------------|----------------|---------------|---------------------|
| Forest, gully, E slope    | 54.5081 36.2677                  | city centre                    | Wood dominated by box-elder (Acer negundo) and maple (Acer platanoides) with ruderal weeds | 7.39 | 03/05/2003 27/09/2003 | 15 | 03-Zh |
| Forest, gully, bottom     | 54.5064 36.2675                  | city centre                    | Wood dominated by the white willow (Salix alba) and poplars (Populus sp.) with the woolly burdock (Arctium tomentosum), the Himalayan balsam (Impatiens glandulifera), and the stinging nettle (Urtica dioica) | 7.39 | 01/05/2011 22/10/2011 | 15 | 11-Zh |
| Forest, watershed slope   | 54.5069 36.3124                  | city periphery                 | Birch wood with tall mesophile herbs | 18.35 | 23/04/2010 19/10/2010 | 10 | 10-Bb |
| Forest, watershed slope   | 54.5378 36.2542                  | city centre                    | Grassy pine forest               | 57.07 | 20/04/1994 01/10/1994 | 30 | 94-Kom |
| Forest, watershed slope   | 54.5381 36.2539                  | city centre                    | Pine forest with nemoral herbs and shrubs | 57.07 | 20/04/1995 01/10/1995 | 30 | 95-Kom |
| Forest, gully, S slope    | 54.5382 36.2602                  | city centre                    | Broadleaved forest dominated by oak (Quercus robur), maple (Acer platanoides), and box-elder (Acer negundo) | 57.07 | 18/05/2003-27/09/2003 | 15 | 03-Kom |
| Riparian wooded habitat, main river valley, floodplain | 54.4959 36.2641                  | city centre                    | Fringe of willow-woods (dominated by Salix triandra) on the bank of Oka River, near the waters' edge, with grasses (Bromus inermis dominates), sedges and herbs (Pentanema britannicum) | undefined | 01/05/2015 15/10/2015 | 10 | 15-WW |
| Type of habitat, land form | Coordinates (Latitude, Longitude) | Position in the city structure | Vegetation and land use (optional) | Size of unbuilt area around the plot, ha | Sampling period | Traps number | Plot ID (parent event) |
|---------------------------|----------------------------------|-------------------------------|-----------------------------------|----------------------------------------|----------------|--------------|----------------------|
| Riparian wooded habitat, main river valley, floodplain | 54.4965 36.2644 | city centre | Box-elder (*Acer negundo*) spinney on the bank of Oka River, with sparse herb layer which consists of *Impatiens parviflora*, *Glechoma hederacea*, in some sites *Urtica dioica*, *Aegopodium podagraria* | undefined | 01/05/2015 15/10/2015 | 10 | 15-Bx |
| Riparian wooded habitat, main river valley, floodplain | 54.4985 36.3084 | city centre | Willow-woods (dominated by *Salix triandra*) on the bank of Oka River, in low site, with boxelder, *Rubus*, *Solanum*, *Urtica*, *Arctium*. | undefined | 01/05/2015 15/10/2015 | 10 | 15-W1 |
| Riparian wooded habitat, main river valley, floodplain | 54.4985 36.3079 | city centre | Willow-woods (dominated by *Salix triandra*) on the bank of Oka River, in rather high site, with closed crowns, with boxelder, *Urtica*, *Arctium*. | undefined | 01/05/2015 15/10/2015 | 10 | 15-W2 |
| Yard, watershed slope | 54.5058 36.2853 | city centre | Linear artificial wood dominated by maple (*Acer platanoides*), box-elder (*Acer negundo*), ash (*Fraxinus pensylvanicus*), with tall ruderal herbs | 1.72 | 05/06/2006 11/11/2006 | 12 | 06-Hosp |
| Yard, watershed slope | 54.5082 36.2635 | city centre | Yard consisting of flowerbeds and grass patches, surrounded by pavement and buildings | 1.31 | 02/05/2003 27/09/2003 | 10 | 03-EBCp |
| | | | | | 01/05/2004 20/10/2004 | 10 | 04-EBCp |
| | | | | | 16/04/2007 26/10/2007 | 16 | 07-EBCp |
| Type of habitat, land form | Coordinates (Latitude, Longitude) | Position in the city structure | Vegetation and land use (optional) | Size of unbuilt area around the plot, ha | Sampling period | Traps number | Plot ID (parent event) |
|---------------------------|----------------------------------|-------------------------------|-----------------------------------|----------------------------------------|----------------|--------------|----------------------|
| Yard, watershed slope     | 54.5083 36.2742                  | city centre                   | Stands of trees between buildings in city centre. Dominated by the box-elder, Norway maple and green ash (*Fraxinus pennsylvanica*) with ruderal weeds | 0.148 | 01/05/2011 22/10/2011 | 6 | 11-KSUT |
| Yard, watershed slope     | 54.5092 36.2733                  | city centre                   | Grassy yard between buildings in city centre. Dominated by the cat grass (*Dactylis glomerata*) and Kentucky bluegrass (*Poa pratensis*), with sparse trees of birch and common pear (*Pyrus communis*) | 0.267 | 01/05/2011 22/10/2011 | 8 | 11-KSUh |
| Yard, watershed slope     | 54.5218 36.2612                  | city centre                   | Tree line dominated by lime (*Tilia cordata*) with lawns and buildings | 0.44 | 25/05/2006 07/11/2006 | 15 | 06-TRC |
| Garden, watershed slope   | 54.4808 36.2554                  | suburb                        | Non-tilled garden including apple trees, currant shrubs, weeds. | undefined | 27/05/2009 19/10/2009 | 15 | 09-N |
| Garden, tributary river valley | 54.5081 36.3661               | suburb                        | Garden consisting of apple trees, vegetable plot | undefined | 28/04/1995 06/10/1995 | 12 | 95-Zhd |
| Garden, watershed slope   | 54.5087 36.2638                  | city centre                   | Garden plot with vegetables and decorative flowers and apple orchard in central part and with hedge from box-elder (*Acer negundo*) and common lilac (*Syringa vulgaris*) and clump from the warty birch (*Betula pendula*), English oak (*Quercus robur*), Norway maple (*Acer platanoides*) and green ash (*Fraxinus pennsylvanica*) on the periphery | 1.31 | 20/04/1995 11/10/1995 | 23 | 95-EBC |
|                           |                                  |                               |                                    | | 02/05/2003 27/09/2003 | 15 | 03-EBCg |
|                           |                                  |                               |                                    | | 01/05/2004 20/10/2004 | 15 | 04-EBCg |
|                           |                                  |                               |                                    | | 2007-04-16 2007-10-26 | 26 | 07-EBCg |
|                           |                                  |                               |                                    | | 01/05/2011 22/10/2011 | 15 | 11-EBCg |
|                           |                                  |                               |                                    | | 18/04/2015 01/10/2015 | 15 | 15-EBCg |
| Type of habitat, land form | Coordinates (Latitude, Longitude) | Position in the city structure | Vegetation and land use (optional) | Size of unbuilt area around the plot, ha | Sampling period | Traps number | Plot ID (parent event) |
|---------------------------|----------------------------------|-------------------------------|-----------------------------------|------------------------------------------|----------------|-------------|---------------------|
| Garden, gully, NE slope   | 54.5158 36.2830                  | city centre                   | Moist garden consisting of apple trees, vegetable plot, grass patches | 1.95                                      | 05/05/2006     | 10          | 06-Pod             |
|                           |                                  |                               |                                   | 11/11/2006                               | 20/04/2007     | 12          | 07-Pod             |
|                           |                                  |                               |                                   | 26/10/2007                               | 28/04/2009     | 10          | 09-Pod             |
| Garden, watershed slope   | 54.5250 36.2444                  | city periphery                | Garden                            | 3.58                                      | 07/04/1995     | 20          | 95-Pz              |
|                           |                                  |                               |                                   | 01/10/1995                               | 02/05/2009     | 15          | 09-Vet             |
| Garden, watershed slope   | 54.5272 36.2867                  | city periphery                | Poorly-drained garden. Most of its area is vegetable plot which is tilled many times a year. There are apple trees and currant shrubs. | 30.02 | 02/05/2009 | 29/10/2009 | 15 | 09-Vet             |
| Garden, watershed slope   | 54.5300 36.2550                  | city periphery                | Garden                            | 1.05                                      | 28/04/1995     | 15          | 95-K               |
|                           |                                  |                               |                                   | 04/07/1995                               | 28/04/1995     | 15          | 95-Olg             |
| Garden, watershed slope   | 54.5708 36.3036                  | suburb                        | Garden                            | undefined                                 | 28/04/1995     | 15          | 95-Olg             |
|                           |                                  |                               |                                   | 04/07/1995                               | 01/05/2009     | 13          | 09-Olg1            |
| Garden, watershed slope   | 54.5724 36.2984                  | suburb                        | Garden including apple trees, currant shrubs, flowers, vegetables. Most of its area is tilled twice a year | undefined | 20/10/2009 | 01/05/2009 | 13 | 09-Olg1            |
| Garden, watershed slope   | 54.5753 36.2975                  | suburb                        | Non-tilled garden including apple trees, currant shrubs, weeds. | undefined | 27/05/2009 | 19/10/2009 | 15 | 09-Ig2             |
| Garden, watershed slope   | 54.5968 36.2640                  | city periphery                | School garden with sparse apple trees, flowers and mesotrophic and oligotrophic weeds | 2.95 | 17/05/2008 | 01/11/2008 | 26 | 08-Sev             |
| Garden, tributary river valley | 54.5969 36.2348                | city periphery                | Garden including apple trees, currant shrubs, flowers, vegetables. Most of its area is tilled twice a year | undefined | 29/04/1995 | 04/07/1995 | 15 | 95-Tim             |
| Plot ID | Plot ID | Plot ID |
|---|---|---|
| 09-Tim | 10-BF | 10-BC |

**Grassland, watershed slope**

- **Coordinates**: 54.5072 36.3141
- **Position in the city structure**: city periphery
- **Vegetation and land use**: Grassland (fallow) with recent regeneration of birch (*Betula pendula*) on the site of abandoned field
- **Size of unbuilt area around the plot, ha**: 18.35
- **Sampling period**: 27/05/2009, 19/10/2009
- **Traps number**: 15

**Grassland, watershed slope**

- **Coordinates**: 54.5079 36.3147
- **Position in the city structure**: city periphery
- **Vegetation and land use**: Meadow on a clay site disturbed by road construction activity dominated by wood small-reed (*Calamagrostis epigejos*) with tall herbs.
- **Size of unbuilt area around the plot, ha**: 18.35
- **Sampling period**: 23/04/2010, 19/10/2010
- **Traps number**: 10

**Grassland, main river valley, S slope**

- **Coordinates**: 54.5089 36.2333
- **Position in the city structure**: city centre
- **Vegetation and land use**: Dry grassland on road embankment
- **Size of unbuilt area around the plot, ha**: 0.44
- **Sampling period**: 01/06/2001, 01/09/2001
- **Traps number**: 4

**Grassland, watershed slope**

- **Coordinates**: 54.5290 36.2951
- **Position in the city structure**: city periphery
- **Vegetation and land use**: Lawn between road and pavement dominated by cattail grass (*Phleum pratense*), cocksfoot (*Dactylus glomerata*) and legumes, with poplar trees
- **Size of unbuilt area around the plot, ha**: 3.12
- **Sampling period**: 17/04/2007, 25/10/2007
- **Traps number**: 8

**Grassland, watershed slope**

- **Coordinates**: 54.5292 36.2972
- **Position in the city structure**: city periphery
- **Vegetation and land use**: Railway bank of east-south-east exposition overgrown by *Bromus inermis*, *Vicia cracca* and other legumes and forbs
- **Size of unbuilt area around the plot, ha**: 3.12
- **Sampling period**: 17/04/2007, 25/10/2007
- **Traps number**: 15

**Grassland, watershed slope**

- **Coordinates**: 54.5294 36.2967
- **Position in the city structure**: city periphery
- **Vegetation and land use**: Linear site between railway and pavement, sometimes wet. Dominated by *Festuca pratense* with significant contribution of *Centarea jacea*, *Medicago falcata* and other Asteraceae and Fabaceae, locally dominated by *Calamagrostis epigejos*, locally with sparse poplar trees
- **Size of unbuilt area around the plot, ha**: 3.12
- **Sampling period**: 17/04/2007, 25/10/2007
- **Traps number**: 12
| Type of habitat, land form | Coordinates (Latitude, Longitude) | Position in the city structure | Vegetation and land use (optional) | Size of unbuilt area around the plot, ha | Sampling period | Traps number | Plot ID (parent event) |
|----------------------------|-----------------------------------|-------------------------------|-----------------------------------|----------------------------------------|----------------|--------------|----------------------|
| Grassland, watershed slope | 54.5473 36.3147 | city periphery | Mesophile meadow dominated by randall (*Festuca pratense*), cocksfoot (*Dactylus glomerata*) and lady’s-mantle (*Alchemilla*), with hygrophilic herbs | 6.48 | 08/06/2006 07/11/2006 | 13 | 06-O |
| Grassland, tributary river valley | 54.5918 36.2267 | city periphery | Tall-grass meadow on railway embankment near river and forest | undefined | 05/06/2006 11/08/2006 | 15 | 06-Sil2 |
| Grassland, tributary river valley | 54.5929 36.2266 | city periphery | Tall-grass meadow on railway embankment near river and forest | undefined | 05/06/2006 11/08/2006 | 15 | 06-Sil1 |
| Former quarry, watershed slope | 54.5966 36.1992 | suburb | Calcareous rocky outcrops with single willows and seabuckthorns | undefined | 19/04/2010 23/10/2010 | 10 | 10-MR |
| Former quarry, watershed slope | 54.5988 36.2036 | suburb | Grassland dominated by *Calamagrostis epigeios* in open-pit bottom | undefined | 19/04/2010 23/10/2010 | 10 | 10-MG |
| Former quarry, watershed slope | 54.5992 36.1981 | suburb | Young site of open-pit bottom with pond and willow-shrub. | undefined | 19/04/2010 23/10/2010 | 10 | 10-MP |
| Former quarry, watershed slope | 54.5995 36.1993 | suburb | Grove dominated by pine, birch, willows and seabuckthorn. | undefined | 19/04/2010 23/10/2010 | 10 | 10-MW |
| Former quarry, watershed slope | 54.5996 36.1965 | suburb | Open-pit side with clay soils overgrown with legumes and forbs herb layer | undefined | 19/04/2010 23/10/2010 | 10 | 10-MC |
Investigated sites can be grouped into six types of habitats which are characteristic of the urban area:

1. **Forests** (Fig. 2, Fig. 3) – habitats with area > 0.5 ha where the dominant vegetation is trees with a canopy cover of at least 10%. In Kaluga, such habitats are located mainly in gullies and ravines. These sites are slightly managed and anthropogenic impact manifests mainly as littering. These forests are deciduous with *Acer platanoides*, *Tilia cordata*, *Quercus robur*, *Acer negundo*, *Ulmus* spp., *Populus* sp. and *Salix* spp. The herb layer is

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### Table 2.

Descriptive characteristics of carabid samples for different types of habitats in the City of Kaluga.

| Group                | Sample (plot by year) number | Total species | Species number | Shannon Index |
|----------------------|------------------------------|---------------|----------------|---------------|
|                      |                              |               | median | min | max | median | min | max |
| Forest               | 15                           | 130           | 51.0   | 28  | 84  | 2.58   | 1.73 | 2.81 |
| Riparian wooded habitat | 4                           | 99            | 51.5   | 33  | 83  | 2.45   | 1.90 | 3.18 |
| Yard                 | 7                            | 88            | 38.0   | 24  | 54  | 2.48   | 2.20 | 3.11 |
| Garden               | 20                           | 149           | 53.5   | 34  | 65  | 2.82   | 2.08 | 3.19 |
| Grassland            | 9                            | 115           | 46.0   | 27  | 56  | 2.58   | 2.04 | 2.94 |
| Quarry               | 5                            | 191           | 42.0   | 33  | 56  | 2.43   | 2.33 | 2.98 |

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Figure 1. Location of surveyed habitats in Kaluga City and vicinities. Plot codes are the same as in Table 1 and correspond to parentEventID in the dataset.
mainly shaped by nitrophilous weeds or nemoral herbs, which are stress-tolerators or ruderals. In one forest, the dominant tree was *Pinus sylvestris* and, in another, it was silver birch (*Betula pendula*).

2. **Riparian wooded habitats** (Fig. 4) – sites along river, shaped by *Salix triandra* and other small *Salix* spp. or box-elder (*Acer negundo*). The herb layer is mainly shaped by ruderal weeds and locally, there are deadcover patches. Formally, they can be considered
as a forest, but they have some distinguishing habitat features: they are very narrow (about 20 m) and strongly impacted by the river. Riparian species have a large proportion in the ground beetle assemblages. Therefore, we distinguished this habitat as a distinct type.

3. **Yards** (Fig. 5) – building areas with lines of trees, ornamental gardens and small parks beside houses or in city squares. These habitats consist of small groups of trees, grassy patches, flowerbeds surrounded by buildings and pavement with artificial surfaces.

![Figure 4](https://example.com/figure4.jpg)

**Figure 4.** Box-elder (*Acer negundo*) spinney on the bank of Oka River (Bx).

3. **Yards** (Fig. 5) – building areas with lines of trees, ornamental gardens and small parks beside houses or in city squares. These habitats consist of small groups of trees, grassy patches, flowerbeds surrounded by buildings and pavement with artificial surfaces.

![Figure 5](https://example.com/figure5.jpg)

**Figure 5.** Yard with grass patches (EBCp).

4. **Gardens** – habitats with a mosaic of cultivated trees and shrubs (mainly fruit) and herbs (vegetable or ornamental) without large buildings, roads and pavements (Fig. 6, Fig. 7).
They include kitchen and allotment gardens. Soils are regularly tilled and irrigated. In Kaluga, gardens are aggregated to more or less large arrays. Some plots were fallow and were overgrown by ruderal herbs in the year of sampling.

5. **Grasslands** (Fig. 8) – in Kaluga City, grasslands are located mainly in wastelands between industrial buildings and protected belts along roads and railways. Sometimes,
there are poor sites with *Calamagrostis epigeios* and, sometimes, there are plots dominated by mesophile grasses (*Festuca pratense, Dactylus glomerata, Phleum pratense*); sometimes, there are poorly-drained sites with hygrophilic grasses and sedges.

6. **Former quarry** – the set of the biotopes on the slopes and bed of limestone the quarry, finally abandoned at least 30 years ago. The surveyed quarry is located in the northwest suburb and surrounded by spruce and pine forests. There is a village about one kilometre towards the north (Fig. 9). This type of habitat provides the possibility to investigate primary succession in vegetation and soil fauna population. That is why we consider this place as a distinct type of area.
**Sampling description:** The beetles were collected with soil pitfall traps (0.5 l transparent plastic cups with a mouth of 85 mm in diameter filled to about a third (150 ml) with 4% formalin solution, with covers made of transparent polyethylene film). For the broadleaved forest of the Kaluga Region, we suggested that it needs 30 traps to reveal the species composition of carabids (Alexeev and Aleksanov 2017). Urban habitats are small and frequently disturbed, so we usually expose 15 or 10 traps for small plots. Some neighbouring plots were divided into two habitats after collecting the samples, so trap numbers for each habitat were fewer. Sometimes traps were destroyed by people. Therefore, the number of traps was fewer than 15 or 10 in such cases. For relatively large forests, 30 traps were exposed in some years. Pitfall traps were exposed continuously from April or May to October or November. In some cases, traps were operated for a shorter time, about two or three months (4 plots) or even about one and half months (1 plot, 01-Gag). For most samples, the traps were emptied within an interval of one to three weeks in most cases. Sometimes, the interval was longer, usually at the late season when the activity of carabids was low. Amongst 47 sampling plots, most were sampled once, i.e. during one season, six during two or three seasons and one during six. There were two consecutive seasons (no more) in five cases.

It is worth noting that plots with the same alphabetic acronym in code could be a different biotope (94-Zh, 95-Zh and 03-Zh) or similar biotopes in different, but places situated nearby (97-Ber and 03-Ber). Although such biotopes represented one continuous vegetation area within the same mesorelief form (afforested gullies, for instance), these may be different parts of it.

Thereafter, a series of continuous sampling events within one sampling plot during one season we called a "survey". We investigated 47 habitats (sample plots). Some of them were sampled during two, three or even six seasons. So, a total of 60 surveys were done. Unique values of DwC term parentEventID correspond to a distinct survey.

On each plot within a survey, 4 to 30 traps were established at the beginning of the season, but more often, 15 or 10 (less often). Usually, we chose sites for sampling within private (with the consent of owners), restricted (office territory) or low-attandance areas to ensure non-disturbance of the traps and the continuity of the investigations. Nevertheless, there were some cases of vandalism or unintentional destruction during lawn mowing, building repairing or accidental trampling when someone walked through the site. Trap flooding in the riparian sites has occurred as well. The event table in the DwC archive contains the actual traps number (intact ones) for each sampling event (dwc: samplingEffort). We tended to set the number of traps in multipliers of 5 or 10, but in some cases, the installation of new traps to replace the damaged ones was not possible, because of which the line of traps in a particular plot was shortened. In some sample plots (07-EBCg, 07-GrR, 09-Vet), traps were added after the first sampling when vegetation development has shown that installed traps did not cover the full diversity of the site.

So, in some cases, consecutive sampling events within one survey were based on different amounts of the traps. Dealing with the relative abundance (activity-densities) of carabids, we have considered our data consistent and comparable with others datasets. When traps
were disturbed, the seasonal sum of sampling efforts does not relate to the sampling duration as an integer value (Table 3).

| ID (parent event) | individuals count | number of species | duration, days | sampling efforts, 100 trap days | relative abundance, ex/100 trap days |
|-------------------|-------------------|-------------------|----------------|---------------------------------|-------------------------------------|
| 94-Park           | 2234              | 54                | 164            | 49.2                            | 45.4                                |
| 97-Park           | 2266              | 60                | 164            | 49.2                            | 46.1                                |
| 03-Park           | 1148              | 29                | 124            | 18.6                            | 61.7                                |
| 94-Ber            | 1513              | 44                | 164            | 49.2                            | 30.8                                |
| 97-Ber            | 1774              | 51                | 164            | 49.2                            | 36.1                                |
| 03-Ber            | 1009              | 52                | 138            | 20.7                            | 48.7                                |
| 04-Ber            | 579               | 28                | 169            | 25.35                           | 22.8                                |
| 94-Zh             | 1099              | 63                | 164            | 49.2                            | 22.3                                |
| 95-Zh             | 2164              | 65                | 164            | 49.2                            | 44                                  |
| 03-Zh             | 1103              | 46                | 139            | 20.85                           | 52.9                                |
| 11-Zh             | 918               | 36                | 160            | 24.15                           | 38                                  |
| 10-Bb             | 1788              | 46                | 171            | 16.3                            | 109.7                               |
| 94-Kom            | 1891              | 63                | 164            | 49.2                            | 38.4                                |
| 95-Kom            | 1599              | 65                | 164            | 49.2                            | 32.5                                |
| 03-Kom            | 976               | 39                | 125            | 18.75                           | 52.1                                |
| 15-WW             | 1557              | 83                | 156            | 14.49                           | 107.5                               |
| 15-Bx             | 1100              | 33                | 156            | 15.6                            | 70.5                                |
| 15-W1             | 2731              | 49                | 143            | 13.19                           | 207.1                               |
| 15-W2             | 2269              | 54                | 156            | 15.04                           | 150.9                               |
| 06-Hosp           | 647               | 34                | 154            | 18.48                           | 35                                  |
| 03-EBCp           | 999               | 49                | 148            | 14.8                            | 67.5                                |
| 04-EBCp           | 841               | 51                | 165            | 16.5                            | 51                                  |
| 07-EBCp           | 999               | 54                | 182            | 28.41                           | 35.2                                |
| 11-KSUt           | 471               | 24                | 160            | 9.6                             | 49.1                                |
| 11-KSUh           | 1031              | 34                | 160            | 12.8                            | 80.5                                |
| Code  | Value1 | Value2 | Value3 | Value4 | Value5 |
|-------|--------|--------|--------|--------|--------|
| 06-TRC | 1115   | 38     | 160    | 24     | 46.5   |
| 09-N   | 917    | 34     | 114    | 17.1   | 53.6   |
| 95-Zhd | 1662   | 42     | 43     | 5.16   | 322.1  |
| 95-EBC | 6729   | 84     | 174    | 40.02  | 168.1  |
| 03-EBCg| 2147   | 57     | 148    | 22.2   | 96.7   |
| 04-EBCg| 885    | 51     | 142    | 21.3   | 41.5   |
| 07-EBCg| 2120   | 60     | 182    | 47.93  | 44.2   |
| 11-EBCg| 864    | 49     | 160    | 24     | 36     |
| 15-EBCg| 246    | 39     | 155    | 23.25  | 10.6   |
| 06-Pod | 1377   | 56     | 183    | 18.3   | 75.2   |
| 07-Pod | 2510   | 63     | 180    | 21.94  | 114.4  |
| 09-Pod | 1251   | 61     | 167    | 16.7   | 74.9   |
| 95-Pz  | 1343   | 44     | 177    | 35.4   | 37.9   |
| 09-Vet | 2202   | 54     | 171    | 25.26  | 87.2   |
| 95-K   | 842    | 39     | 67     | 10.05  | 83.8   |
| 95-Olg | 2008   | 45     | 67     | 10.05  | 199.8  |
| 09-Olg1| 1287   | 55     | 163    | 20.32  | 63.3   |
| 09-Ig2 | 1114   | 43     | 123    | 18.45  | 60.4   |
| 08-Sev | 2037   | 64     | 163    | 41.36  | 49.3   |
| 95-Tim | 1984   | 64     | 66     | 9.9    | 200.4  |
| 09-Tim | 999    | 53     | 138    | 20.7   | 48.3   |
| 10-BF  | 958    | 51     | 171    | 16.88  | 56.8   |
| 10-BC  | 583    | 56     | 171    | 15.03  | 38.8   |
| 01-Gag | 627    | 27     | 92     | 3.68   | 170.4  |
| 07-GrL | 267    | 38     | 166    | 13.39  | 19.9   |
| 07-GrR | 338    | 47     | 181    | 26.55  | 12.7   |
| 07-Gr  | 693    | 45     | 181    | 22.65  | 30.6   |
| 06-O   | 830    | 46     | 147    | 19.11  | 43.4   |
| 06-Sil2| 543    | 46     | 67     | 10.05  | 54     |
| 06-Sil1| 1377   | 51     | 67     | 10.05  | 137    |
| 10-MR  | 223    | 38     | 178    | 17.8   | 12.5   |
Samples were sorted for carabids in the laboratory. Numerous and easily-recognisable species collected in 2003-2015 were identified by Victor Aleksanov. Specimens of those species, which were difficult to determine and all specimens collected before 2003, were identified by Sergey Alexeev. For identification, we used the following keys: Gureva and Kryzhanovskii (1965), Mandl (1983), Angus et al. (2001), Isaev (2002), Freude et al. (2004), and Arndt et al. (2011). Identification of some doubtful specimens was checked out by the taxonomists Kirill Makarov, Andrey Matalin, Boris Kataev, Evgeniy Komarov, Dmitry Fedorenko and Igor Sokolov. After identification and counting, almost all specimens were disposed. Specimens of some species were dissected to determine the generative state. Some specimens of rare species were preserved and included in the private collection of Sergey Alexeev.

To describe and visualise carabid assemblages, we used non-metric multidimensional scaling based on Bray-Curtis Dissimilarity (qualitative), species number and Shannon Diversity Index. This data processing was performed in vegan R package (Oksanen et al. 2020).

**Step description:**

1. Sample plots were chosen in different kinds of urban habitats.
2. The beetles were sampled by pitfall traps during a whole season or, in some cases, a shorter period (1-3 months).
3. The beetles were identified and counted.
4. The dataset was compiled. This dataset includes raw data - the number of individuals sampled during the period between trap installation and the first sampling of two consecutive samplings. The relative abundance in units of ind./100 trap days were calculated as well.

Overall, investigations covered 13 seasons during a time span of 22 years. Unfortunately, we were not able to save all of the primary data. Therefore, we could not provide data on every sampling event for 17 surveys. For these, we have data summarised for the entire season. In such cases dwc: eventID and dwc: parentEventID are the same and sampling event means the whole season of sampling, which includes several actual events. In total, data on each sampling event are available for 41 surveys from 37 plots.

**Geographic coverage**

**Description:** The European part of Russia, Kaluga Oblast, Kaluga Urban Okrug, Kaluga City. The location of the sample plots was measured using Google Maps and Yandex Maps.
web services for plots established before 2003 and with satellite navigator (GPS) for ones studied later. Decimal degrees geographic coordinates are provided according to WGS 84 datum. Coordinates of sampling plots are available in Table 1.

**Coordinates:** 54.4808 and 54.5996 Latitude; 36.1965 and 36.3661 Longitude.

## Taxonomic coverage

**Description:** Taxonomic coverage is given according to the GBIF Backbone Taxonomy (GBIF Secretariat 2011). This section of the Backbone derives from the Catalogue of Life (Anonymous 2011) and is curated by Wolfgang Lorenz (Lorenz 2021). The Catalogue of Palearctic Coleoptera, compiled with the participation of several Russian carabidologists, was also used (Löbl and Löbl 2017).

In total, 189 species and 79091 specimens are included in this dataset. We identified one subspecies: *Harpalus xanthopus winkleri* Schauberger, 1923, but since there are no other subspecies, we consider it as a species.

In the NMDS ordination graph, two groups of samples are distinctly divided from samples of other types of habitats (Fig. 10). They are habitats of a former quarry and riparian habitats. Non-riparian forests, gardens and yards are not clearly distinguished from each other. Species richness (number of species) of surveys ranged between 24 and 84 species (Table 2). More species from diverse biotopes are riparian habitats and gardens.

![NMDS ordination graph (Bray-Curtis Dissimilarity)](image-url)
This dataset contains most of the data on which the monograph “Inventory of the Ground Beetles (Coleoptera, Carabidae) of Kaluga Urban Okrug” (Aleksanov and Alexeev 2019) is based. In this book, we recorded 235 carabid species since 1994 to 2015. Four species were only caught in one suburban habitat and hence not included in this dataset because the list of species from this habitat is not completed yet. Other species were only collected by hand or window traps.

**Taxa included:**

| Rank | Scientific Name | Common Name |
|------|-----------------|-------------|
| family | Carabidae | Ground beetles |

**Usage licence**

Usage licence: Other

IP rights notes: Attribution 4.0 International (CC BY 4.0)

**Data resources**

Data package title: Ground beetles (Carabidae) in urban habitats of Kaluga City (Russia)

Resource link: https://www.gbif.org/dataset/5b4ba541-ad87-4d28-b8ca-a803335fd49d

Alternative identifiers: http://gbif.ru:8080/ipt/resource?r=new_carabidae_kaluga_city1

Number of data sets: 1

Data set name: Ground beetles (Carabidae) in urban habitats of Kaluga City (Russia)

Data format: Darwin Core Archive format

Description: The dataset includes two related tables related by the eventID field – Events and Associated occurrences (Aleksanov and Alekseev 2021). The Event table consists of 13 fields, the Associated occurrences table - 12 fields. The occurrence table includes occurrence-present as well as occurrence-absent records.

| Column label | Column description |
|--------------|-------------------|
| eventID( Event Core, Occurrence Extension) | An identifier for the sample plot and the trapping period. https://dwc.tdwg.org/terms/dwc:eventID A key field for relation between tables, categorical, 425 unique values, examples: "94-Park", "15-Bx-2015-09-12" |
| parentEventID (Event Core, Occurrence Extension) | An identifier for the sample plot. https://dwc.tdwg.org/terms/#dwc:parentEventID ID of season whole trapping period, in some cases eventID = parentEventID. Categorical, 60 unique values, examples: "94-EBC", "97-Park", "08-Sev". |
| Field                          | Description                                                                 | Constraints                                                                 |
|-------------------------------|------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| samplingProtocol              | Sampling protocol.                                                           | Textual description, constant: "soil pitfall traps"                        |
| samplingEffort                | Amount of trap-days for each sampling term.                                  | Textual description, example: "15 pitfall traps per 13 days"               |
| habitat                       | Description of the habitat.                                                  | Textual description, examples: "Garden including apple trees", "Grassy pine forest" |
| countryCode                   | The standard code for the Russian Federation according to ISO 3166-1-alpha-2. | Categorical, constant: "RU"                                                 |
| locality                      | The specific description of the place.                                       | Brief textual description, 31 unique values, examples: "Kaluga city, Gagarina street", "Kaluga city, Berezujsky gully" |
| decimalLatitude               | The geographic latitude in decimal degrees of the geographic centre of the data sampling place. | Numerical variable of decimal type with a precision of 6 and scale of 4 ranged between 54.4808 and 54.5996 |
| decimalLongitude              | The geographic longitude in decimal degrees of the geographic centre of the data sampling place. | Numerical variable of decimal type with a precision of 6 and scale of 4 ranged between 36.1965 and 36.3661 |
| geodeticDatum                 | Spatial reference system (SRS) upon which the geographic coordinates are given in decimalLatitude and decimalLongitude are based. | Categorical, constant: "WGS84"                                               |
| coordinateUncertaintyInMetres | The maximum uncertainty distance in metres.                                  | Numerical variable of integer type, constant: 50                           |
| eventDate                     | Trap period (YYYY-MM-DD/YYYY-MM-DD).                                         | Date, 183 unique values, example: '2007-05-29/2007-06-05'                    |
| startDayOfYear                | The earliest integer day of the year on which the Event occurred.            | Numerical, ranged between 97 and 282                                        |
| endDayOfYear                  | The latest integer day of the year on which the Event occurred.              | Numerical, ranged between 118 and 315                                       |
| occurrenceID                  | An identifier for the occurrence.                                            | Numerical, integer counter with values between 1 and 84971                  |
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