



All records of rodents (Mammalia, Rodentia) and hares (Mammalia, Lagomorpha) in Georgia from 1855 through to 2022

Alexander Buknikashvili[‡], Andrei Kandaurov[‡], Giorgi Sheklashvili[‡], Ioseb Natradze[‡]

[‡] Institute of Zoology of Ilia State University, Tbilisi, Georgia

Corresponding author: Ioseb Natradze (ioseb.natradze@iliauni.edu.ge)

Academic editor: Nedko Nedyalkov

Received: 28 Jun 2023 | Accepted: 20 Jul 2023 | Published: 22 Aug 2023

Citation: Buknikashvili A, Kandaurov A, Sheklashvili G, Natradze I (2023) All records of rodents (Mammalia, Rodentia) and hares (Mammalia, Lagomorpha) in Georgia from 1855 through to 2022. Biodiversity Data Journal 11: e108740. <https://doi.org/10.3897/BDJ.11.e108740>

Abstract

Background

In Georgia, there are 40 species from 21 genera and nine families of rodents, along with one species from a single genus and a family of hares. The dataset, which includes 3146 records, provides information regarding the presence of these species within 1559 locations. Of the total of 3146 records, 285 records from 281 locations belong to hares, while 2864 records from 1394 locations are associated with rodents. The dataset incorporates data sourced from various institutions, including the Collection of the Institute of Zoology of Ilia State University, the Georgian National Museum, the Collection of the Zoological Institute of Russian Academy of Sciences, the Zoological Museum of Moscow State University, as well as data extracted from literature and our own field data. The method for establishing the dataset included data compilation from all the above-mentioned sources. The dataset includes records from 1855 through to 2022.

New information

In this publication, out of 3146 records, 14.9% are our new unpublished data. The unpublished data were collected from 2004 through to 2022. In total, 26% of all records are literature data, 50% are museum data and 24% are data collected by us. The dataset includes data obtained from literature sources, museum collections and the field observations. It includes occurrences of species found in the same locality, but within different years, resulting in separate records for each location. The dataset provided has the potential to significantly contribute to our understanding of the distribution of rodents and hares in Georgia.

Keywords

mammals, rodents, lagomorphs, dataset, distribution, Caucasus, species, occurrence.

Introduction

In Georgia, the survey of rodents (Rodentia) was started in the 18th century (Güldenstädt 1791, Pallas 1811) and was continued by Nordmann (1840). Further surveys were unsystematic, samples being collected for different European museums, including for Museums of the Russian Empire, as well as the Caucasus Museum (now the National Museum of Georgia). The samples stored in the 19th century in the Caucasus Museum were published by Radde (1899).

The next step in the study of small mammals in Georgia was associated with the name of Konstantin Satunin, who worked in the Caucasus from 1893 to 1915. In his publications, Satunin (Satunin 1898, Satunin 1903, Satunin 1908, Satunin 1909, Satunin 1912, Satunin 1913, Satunin 1920) described a few new species, brought into order the taxonomy of Caucasian mammals and published the zoogeographic zoning for the Caucasus for the first time. It is noteworthy that K. Satunin is an author of the section on vertebrate animals in the publication of Radde (1899).

During the years 1916-1917, the Transcaucasian Experimental Station played a significant role in collecting samples of small mammals. The samples collected by the Station's employees are currently stored in the S. Janashia National Museum of Georgia. These samples were later used by many researchers and they have not lost their relevance even today.

Large-scale studies of small mammals are related to M.V. Shidlovskiy who was working at the Institute of Zoology and published more than 20 articles and monographs, including publications on rodents (Shidlovskiy 1919a, Shidlovskiy 1919b, Shidlovskiy 1938, Shidlovskiy 1940a, Anonymous 1940b, Shidlovskiy 1941a, Shidlovskiy 1941b, Shidlovskiy 1945, Shidlovskiy 1947a, Shidlovskiy 1947b, Shidlovskiy 1948, Shidlovskiy 1950, Shidlovskiy 1951, Shidlovskiy 1953, Shidlovskiy 1954a, Shidlovskiy 1954b, Shidlovskiy

1956, Shidlovskiy 1964, Shidlovsky 1976). The work "Rodents of Georgia - Faunistic structure and ecological-geographical spreading" (1948), existed as a report until 2013 and was published in 2013 (Shidlovskiy 2013). Parts of the work were published in articles dedicated to different regions of the country (Shidlovskiy 1948, Shidlovskiy 1950, Shidlovskiy 1951). The species and subspecies described by Shidlovskiy (1919a), Shidlovskiy (1919b) and Shidlovskiy (1938) and his ideas about the intraspecific heterogeneity of some species (Shidlovskiy 1954a, Shidlovskiy 1956) were not recognised by most of the zoologists at that time. However, these ideas are still actual and most of the taxa he described are considered valid species or subspecies today.

Valuable data about rodents and hare are in the publications of S. Kokhia (Kokhia 1950, Kokhia 1956, Kokhia 1958, Kokhia 1960, Kokhia 1961, Kokhia 1967, Kokhia 1968, Kokhia 1974a, Kokhia 1974b). These publications cover various aspects, including general rodentological information and specific studies dedicated to individual species. Information about the distribution of small mammals in Georgia is also given in the following publications (Papava (1940), Enukidze (1951a), Enukidze (1951b), Papava 1953, Papava 1955, Enukidze 1958, Papava 1959, Morgilevskaya 1960, Papava 1960, Morgilevskaya 1974, Enukidze et al. 1977, Enukidze and Zarqua 1985, Morgilevskaya 1989, Morgilevskaya and Tskipurishvili 1989). Furthermore, important information regarding the fauna of small mammals in certain administrative regions of Georgia is presented in the works of Avaliani (Avaliani 1969a, Avaliani 1969b, Avaliani 1970, Avaliani 1973, Avaliani 1976), As well as in the publications of parasitologists (Rodonaia 1956, Alania et al. 1964, Alania et al. 1971, Matsaberidze 1976, Kurashvili et al. 1977, Sagdieva and Kandaurov 1985, Kurashvili et al. 1989, Sagdieva et al. 2002).

An important role in the research of rodents in Georgia played S. Ognev (Ognev 1940, Ognev 1950), who described in detail the distribution, systematics and biology of rodents living here. Significant data about rodents of Georgia are in the publication Verestchagin (1959); however, these data are given on the maps, without naming toponyms and, therefore, they can be connected/linked to any place only approximately. In addition, data collected in Georgia are used in different publications of foreign researchers (Vorontsov et al. 1992, Lavrenchenko et al. 1994, Orth et al. 1996, Kotenkova 2002, Jaarola et al. 2004, Kryštufek and Vohralik 2005, Kryštufek and Vohralik 2009, Kotenkova et al. 2016).

Additionally, it should be mentioned that, except for the Simon Janashia National Museum of Georgia, samples collected in Georgia during the research of rodents and hares, are stored in the collection of the Institute of Zoology of Ilia State University (Kandaurov and Tskhadaya 2014, Kandaurov et al. 2015, Tskhadaya et al. 2019).

The rodent distribution and systematics studies are underway (Kandaurov 1995, Bukhnikashvili 2004, Bukhnikashvili and Chkhikvadze 2004, Bukhnikashvili et al. 2012a, Bukhnikashvili et al. 2012b, Bukhnikashvili et al. 2013, Bukhnikashvili et al. 2015, Anonymous 2016, Yanchukov et al. 2020). Today, most of the territory of Georgia has been studied in terms of hare and the rodent species distribution, there being gaps left in high mountainous areas of the country. In high mountainous areas, above 2500 m, there are only 42 records from 27 locations and above 3000 m - only one record from one location.

Sampling methods

Description: The dataset includes information about 3146 records of 41 species of 22 genera of 10 families and two orders collected from 1855 through to 2022.

Sampling description: The dataset includes data from literature collected from sources in Georgian, Russian and English languages, the museum data and data collected directly from field observations. Of the dataset, 76% is literature and collection data from 68 different sources. Of them, four are collections and 64 are publications. From these sources, we retrieved the maximum available data, such as date, habitat description, sampling place, closest settlement etc. We used the name of locations and, based on habitat descriptions mentioned in the publications or labels in the collection samples, we tried to identify coordinates using Google Earths services. A significant part of the records retrieved from literature sources is taken from those publications where the species distribution data first appeared for Georgian territory.

There is a difference between the number of records obtained from literature and the number of records containing unpublished data on each species (Table 1, Fig. 1, Fig. 2).

Table 1.

Number of records for each species.

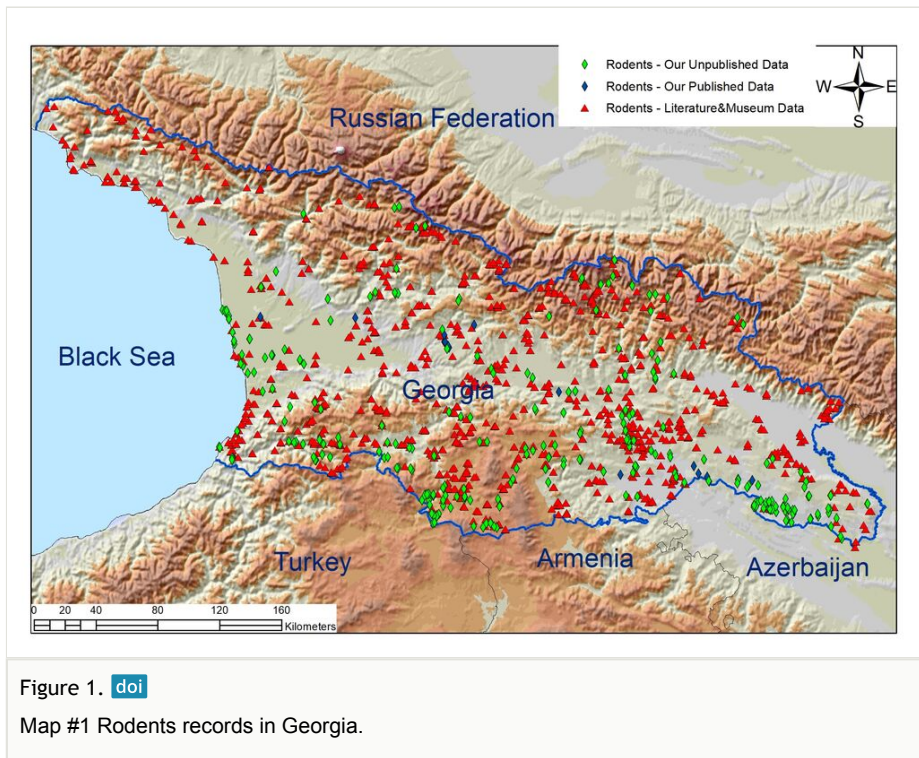
	Scientific name	Endemics and sub-endemics to the Caucasus Ecoregion (Zazanashvili et al. 2020)	Number of records	Literature & Museum data	Our published data	Our Unpublished data
	Lagomorpha					
	Leporidae					
	Lepus					
1	<i>Lepus europaeus</i> Pallas, 1778		285	258	9	18
	Rodentia					
	Sciuridae					
	Sciurus					
2	<i>Sciurus anomalus</i> Gldenstdt, 1785		71	69	0	2
3	<i>Sciurus vulgaris</i> Linnaeus, 1758		54	48	2	4
	Hysteridae					
	Hystrix					

	Scientific name	Endemics and sub-endemics to the Caucasus Ecoregion (Zazanashvili et al. 2020)	Number of records	Literature & Museum data	Our published data	Our Unpublished data
4	<i>Hystrix indica</i> Kerr, 1792		5	0	4	1
	Echimyidae					
	<i>Myocastor</i>					
5	<i>Myocastor coypus</i> (Molina, 1782)		42	17	7	18
	Gliridae					
	<i>Glis</i>					
6	<i>Glis glis</i> (Linnaeus, 1766)		117	107	5	5
	<i>Dryomys</i>					
7	<i>Dryomys nitedula</i> (Pallas, 1778)		110	88	15	7
	Sminthidae					
	<i>Sicista</i>					
8	<i>Sicista caucasica</i> Vinogradov, 1925	+	3	3	0	0
9	<i>Sicista kluchorica</i> Sokolov, Kovalskaya & Baskevich, 1980	+	6	5	0	1
10	<i>Sicista kazbegica</i> Sokolov, Baskevich & Kovalskaya, 1986	+	8	7	0	1
	Dipodidae					
	<i>Scarturus</i>					
11	<i>Scarturus elater</i> (Lichtenstein, 1828)		6	3	0	3
12	<i>Scarturus williamsi</i> (Thomas, 1897)		2	0	2	0
	Spalacidae					
	<i>Nannospalax</i>					
13	<i>Nannospalax xanthodon</i> (Nordmann, 1840)		41	22	4	15

	Scientific name	Endemics and sub-endemics to the Caucasus Ecoregion (Zazanashvili et al. 2020)	Number of records	Literature & Museum data	Our published data	Our Unpublished data
	Cricetidae					
	Cricetulus					
14	<i>Cricetulus migratorius</i> (Pallas, 1773)		77	67	7	3
	Mesocricetus					
15	<i>Mesocricetus brandti</i> (Nehring, 1898)		97	55	20	22
16	<i>Mesocricetus raddei</i> (Nehring, 1894)	+	1	1	0	0
	Prometheomys					
17	<i>Prometheomys schaposchnikovi</i> Satunin, 1901	+	49	45	1	3
	Myodes					
18	<i>Myodes glareolus</i> (Thomas, 1906)		4	4	0	0
	Ondatra					
19	<i>Ondatra zibethicus</i> Link, 1795		8	0	3	5
	Arvicola					
20	<i>Arvicola amphibius</i> (Linnaeus, 1758)		87	72	2	13
	Chionomys					
21	<i>Chionomys nivalis</i> (Martins, 1842)		30	26	0	4
22	<i>Chionomys gud</i> Satunin, 1909	+	70	60	2	8
23	<i>Chionomys lasistanius</i> Neuhäuser, 1936		9	9	0	1
24	<i>Chionomys roberti</i> (Thomas, 1906)	+	75	66	4	5
	Microtus					

	Scientific name	Endemics and sub-endemics to the Caucasus Ecoregion (Zazanashvili et al. 2020)	Number of records	Literature & Museum data	Our published data	Our Unpublished data
25	<i>Microtus majori</i> (Thomas, 1906)		188	151	21	26
26	<i>Microtus daghestanicus</i> (Shidlovsky, 1919)	+	102	73	7	22
27	<i>Microtus socialis</i> (Pallas, 1773)		171	124	31	16
28	<i>Microtus obscurus</i> (Eversmann, 1841)		165	140	5	20
29	<i>Microtus rossiaemeridionalis</i> Ognev, 1924		1	0	0	1
	Muridae					
	Meriones					
30	<i>Meriones tristrami</i> Thomas, 1892		8	7	0	1
31	<i>Meriones libycus</i> Lichtenstein, 1823		66	21	3	42
	Micromys					
32	<i>Micromys minutus</i> (Pallas, 1771)		7	5	1	1
	Apodemus					
33	<i>Apodemus agrarius</i> Pallas, 1771		17	13	3	1
34	<i>Apodemus uralensis</i> Pallas, 1811		245	147	34	64
35	<i>Apodemus witherbyi</i> (Thomas, 1902)		278	177	45	56
36	<i>Apodemus ponticus</i> Sviridenko, 1936	+	74	47	19	8
37	<i>Apodemus mystacinus</i> Danford & Alston, 1877		54	39	1	14
	Mus					

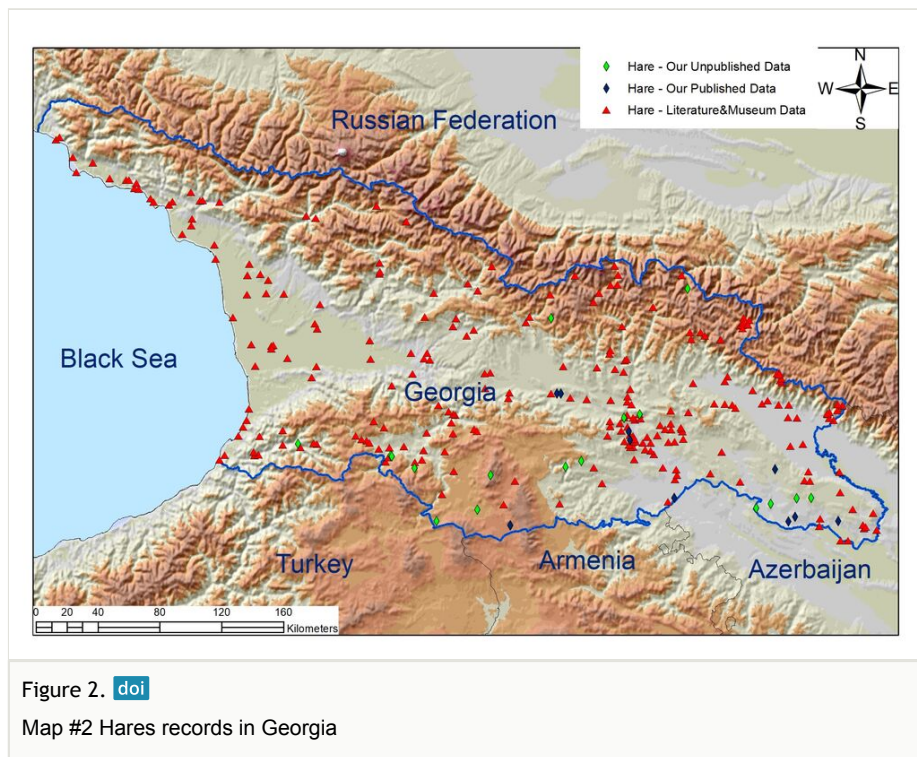
	Scientific name	Endemics and sub-endemics to the Caucasus Ecoregion (Zazanashvili et al. 2020)	Number of records	Literature & Museum data	Our published data	Our Unpublished data
38	<i>Mus musculus</i> Linnaeus, 1758		270	225	19	26
39	<i>Mus macedonicus</i> Petrov & Ruzic, 1983		55	15	18	22
	<i>Rattus</i>					
40	<i>Rattus rattus</i> (Linnaeus, 1758)		92	84	2	6
41	<i>Rattus norvegicus</i> (Berkenhout, 1769)		96	90	1	5



Our field data were collected from 1982 through 2022. During surveys, most samples were caught using snap-traps (Hero traps), the lesser part trapped using live-traps and using pitfall traps (cylinders). Depending on the objectives, 20 to 50 traps were exposed with a distance between traps from five to ten metres (Sheftel 2018). In recent days, most animals have been caught using the Sherman live traps. Animal dissections and

measurements are done following the recent protocols (Herbretau et al. 2011). Only samples identified at the species level were included in the dataset.

The vole *Microtus rossiaemerdionalis* was recorded in Georgia in 2022 for the first time. That is a new species to the Georgian rodent fauna. The presence of this species was confirmed by molecular methods (Ratnasingham and Hebert 2007, Astrin and Stüben 2008, Astrin et al. 2016, Kumar et al. 2018, Sayers et al. 2021). The closest known occurrence of this species is in Turkey, where it lives in the mountains and on the Black Sea coast (Kryštufek and Vohralik 2005).



Quality control: Records taken from literature and museums were included in the dataset only if we were able to determine their coordinates. For samples without coordinates obtained from old museum collections, published sources and our field data before 2004, we did georeferencing using Google Earth. The coordinates are given in degree decimal format in the WGS84 system. The precision of the coordinates depends on the source. In the case of our field observation, using the GPS device, it is presented in the dataset as having a precision of about 30-100 m. However, it should be mentioned that our original field data have a precision of four metres. In the case of data from literature and collections, we obtained an accuracy of about 800-1000 m. The spatial distribution of the finding points within the limits of the study area is shown on the map.

In addition, not all records in literature and the collection have dates. We were able to find information on dates for about 74.5% of records (Fig. 2).

Geographic coverage

Description: The dataset provides information about 3146 records of rodents and hares from 1559 locations in the country of Georgia (Fig. 1, Fig. 2). Georgia, covering an area of 69,700 km², is located on the border of Europe and Asia. More than 80% of its territory is covered by ridges and plateaus. From the physical-geographical point of view, Georgia consists of five districts, namely: (i) Caucasus highland districts, (ii) Colchis District, (iii) Kura (Mtkvari) River Valley/lowland District, (iv) Lesser Caucasus District and (v) Volcanic Highland District of South Georgia (Ukleba 1981b).

Georgia's landscapes are also diverse, starting from the semi-deserts in Eastern Georgia and the humid subtropics in Colchis, ending with the snow glaciers in the Greater Caucasus chain. Georgia is a mainly mountainous country and, accordingly, the change in natural components according to the elevation is well expressed and, accordingly, there is a full spectrum of altitudinal zonation of landscapes (Ukleba 1981a).

Different researchers recognise a different number of landscape types in the Caucasus and particularly in Georgia (Beruchashvili 2000). We rely on Ukleba (1981b), according to whom there are 11 landscape types in Georgia: 1. Humid subtropical landscapes of Colchis lowland; 2. Thorn-bush steppe landscapes of dry subtropical plains; 3. Bluestem grass steppe landscapes of dry subtropical plains; 4. Steppes, shrublands and light forests landscapes of semi-arid subtropical plains and low-mountain; 5. Landscapes of the moderately humid subtropical plains; 6. Semi-desert landscapes of lowland plains; 7. Colchic forest landscapes of humid mountains; 8. Forest landscapes of the moderately humid eastern Transcaucasian mountains; 9. Landscapes of the mountain steppes; 10. High-mountain meadow landscapes (sub-alpine-alpine-meadow); 11. Nival landscapes and glaciers of the high mountains of the Greater Caucasus. A separate, azonal type is the floodplain landscape formed along the main rivers of Georgia, which consists of alder or willow in western Georgia and in the mountains and in the plains of eastern Georgia, so-called tugai-forests are formed and are characteristic only for the Caucasus and Central Asia.

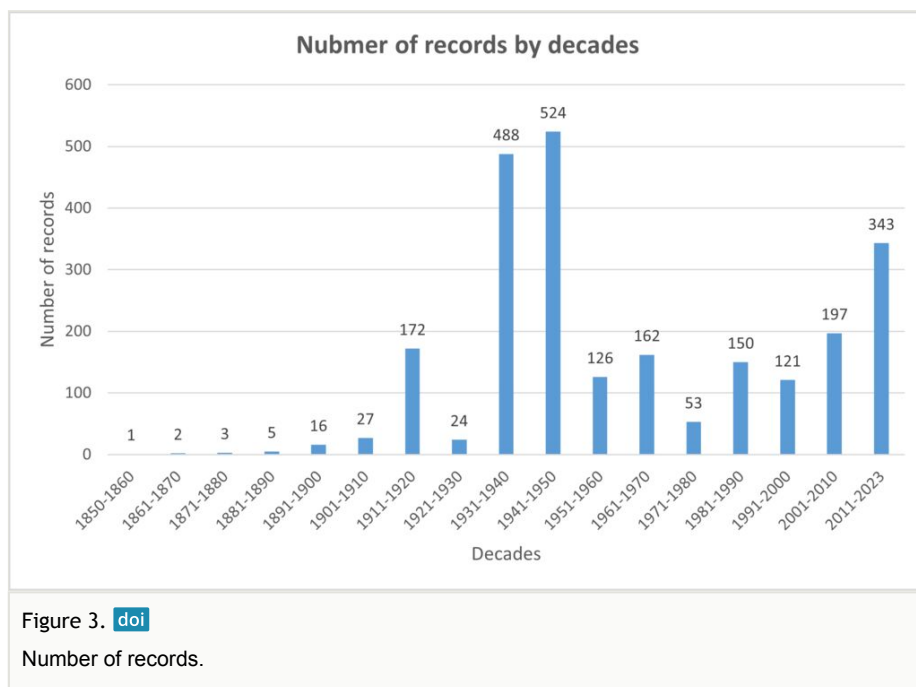
Georgia is a part of the Caucasus Hotspot (Mittermeier et al. 2011), one of 36 biodiversity hotspots in the world, with high species and subspecies diversity.

Of 1559 locations, 479 locations which make up 30.7% are locations obtained during the surveys we conducted and, out of them, 333 (which make up 69.5%) are unpublished locations. Additionally, we increased the intensity studying of rodents and hares in the areas such as semi-arid and arid zones.

Coordinates: 40.94 N and 43.81 N Latitude; 39.66 E and 46.93 E Longitude.

Temporal coverage

Notes: From 1855 through to 2022, surveys were carried out with different intensities. If we divide the survey period into decades, we will see that the most intensive research was conducted between 1931-1950 and from 2011 through 2022 (Fig. 3).



Usage licence

Usage licence: Creative Commons Public Domain Waiver (CC-Zero)

Data resources

Data package title: Rodent occurrence in Georgia

Resource link: <https://www.gbif.org/dataset/81394c45-1942-4689-bfc5-e053ed33b7cc>

Alternative identifiers: https://cloud.gbif.org/eca/resource?r=geo_rodents

Number of data sets: 1

Data set name: Rodent occurrence in Georgia

Data format: Darwin Core Archive (DwC-A)

Description: The dataset contains information on 3146 sampling points records for the 40 species of rodents and one species of hare in Georgia. The occurrences were recorded between the years 1855 and 2022 (Buknikashvili et al. 2023). Each record in the dataset contains the following information: species name, locality name, known event date, coordinates, coordinate uncertainty in metres, altitude, source of information and sources of georeference.

Column label	Column description
occurrenceID	Unique identifier of record.
kingdom	The full scientific name of the kingdom in which the taxon is classified.
phylum	The full scientific name of the phylum 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.
scientificName	Species full scientific (Latin) name including authorship and year.
locality	The specific description of the place of collection.
eventDate	Collection event date.
countryCode	Standard ISO 3166-1-alpha-2 country code.
decimalLatitude	The geographic latitude (in decimal degrees).
decimalLongitude	The geographic longitude (in decimal degrees).
geodeticDatum	Geographic coordinates reference system EPSG.
coordinateUncertaintyInMetres	Coordinate measurement accuracy (metres in case of GPS recordings, NA - if manually georeferenced). However, see the field "dataGeneralisations" for further details.
minimumElevationInMetres	Minimum elevation above sea level.
maximumElevationInMetres	Maximum elevation above sea level.
associatedReferences	Source for the particular record.
georeferenceSources	The system used during the georeferencing.
basisOfRecord	The specific nature of the data record.
institutionCode	The code of the institution where data are stored.
collectionCode	The code of the collection.

Additional information

Field data were collected under the permissions #2722/01; 2302/01; R/057-21, issued by the Ministry of Environmental Protections and Agriculture of Georgia.

Acknowledgements

This work was supported by the Shota Rustaveli National Foundation of Georgia (SRNSFG) as part of the project - Small mammals DNA-barcoding database and verification of fauna composition - [FR-19-2295].

The study was supported by the Defense Threat Reduction Agency (DTRA) as a part of the BAA project entitled "Preparation of the Atlas of Zoonotic Infections in South Caucasus" (HDTRA1-19-1-0044).

The authors are grateful to Dr. Levan Mumladze (Institute of Zoology of Ilia State University) for the assistance regarding the GBIF IPT use and data preparation.

The authors are grateful Dr. Michael Kosoy for his support.

References

- Alania I, Rostigayev V, Shiranovich P, Dzneladze M (1964) Species composition and zonal distribution of fleas. Materials on the flea fauna of Adzharia. Proceedings of the Armenian Anti-Plague Station. Yerevan (3)407-434. [In Russian].
- Alania I, Dzneladze M, Rostigayev B, Shiranovich P (1971) Experience in landscape-ecological analysis of the fauna of small mammals and their fleas in the Adzharian ASSR [Opyt landshaftno-ekologicheskogo analiza fauny melkikh mlekopitayushchikh i ikh blokh Adzharskoy ASSR]. Zoological Journal [Zoologicheskij zhurnal] 50: 561-571.
- Astrin J, Stüben P (2008) Phylogeny in cryptic weevils: molecules, morphology and new genera of western Palaearctic Cryptorhynchinae (Coleoptera:Curculionidae). *Invertebrate Systematics* 22 (5). <https://doi.org/10.1071/is07057>
- Astrin J, Höfer H, Spelda J, Holstein J, Bayer S, Hendrich L, Huber B, Kielhorn K, Krammer H, Lemke M, Monje JC, Morinière J, Rulik B, Petersen M, Janssen H, Muster C (2016) Towards a DNA barcode reference database for spiders and harvestmen of Germany. *PLOS One* 11 (9). <https://doi.org/10.1371/journal.pone.0162624>
- Avaliani R (1969a) On studies Khulo district (Mountain Adjara) mammals. *Bulletin of the State Museum of Georgia by name of S. Janashia* 22-23A: 233-248. [In Georgian].
- Avaliani R (1969b) Materials to study on mammals high-mountain fauna of West Georgia (Tsageri district). *Bulletin of the State Museum of Georgia by name of S. Janashia* 22-23A: 222-232. [In Georgian].
- Avaliani R (1970) Materials to study small mammals of West Georgia (Sachkhere district). *Bulletin of State Museum of Georgia by name of S. Janashia* 26-27: 153-168. [In Georgian].

- Avaliani R (1973) Materials to study small mammals of West Georgia (Zestafoni district). Bulletin of the Simon Janashia State Museum of Georgia 24-25A: 159-177. [In Georgian].
- Avaliani R (1976) On studies of small mammals (Insectivores, Bats, and Rodents) Borjomi district. Bulletin of the Simon Janashia State Museum of Georgia 29-A: 277-291. [In Georgian].
- Beruchashvili N (2000) Landscape diversity of Georgia and geographical analysis of the landscape diversity of the World. In: Beruchashvili N, Kushlin A, Zazanashvili N (Eds) Proceedings of the 1st National Conference: Biological and Landscape Diversity of Georgia. First National Conference: Biological and Landscape Diversity of Georgia, Tbilisi, 2000. WWF Caucasus Office, Tbilisi [In 221-249].
- Buknikashvili A (2004) On cadastre of small mammals (Insectivora, Chiroptera, Lagomorpha, Rodentia) of Georgia. Universal, Tbilisi, 132 pp. [In Georgian].
- Buknikashvili A, Kvavadze E, Eliava I, Natradze I, Beltadze N, Begelauri K (2012a) The register of the fauna of Ajara (Ajara fauna list). Vol. 2. Contour, Tbilisi, 261 pp. [In Georgian]. [ISBN 978-9941-0-3974-4]
- Buknikashvili A, Kvavadze E, Eliava I, Natradze I, Kandaurov A, Beltadze N, Begelauri K (2012b) The register of the fauna of Adjara. Vol. 1. Contour, Tbilisi, 503 pp. [In Georgian]. [ISBN 978-9941-0-3974-4]
- Buknikashvili A, Kandaurov A, Natradze I (2015) Current state of mammals in Guria. Proceedings of the Institute of Zoology 24: 65-95. [In Georgian].
- Buknikashvili A, Kandaurov A, Sheklashvili G, Natradze I (2023) Rodent occurrence in Georgia. 1.1. Institute of Zoology, Ilia State University. Release date: 2023-6-12.
- Buknikashvili A, Chkhikvadze V (2004) Indian crested porcupine (*Hystrix indica*) in Georgia. Bulletin of the Georgian Academy of Sciences 169 (1): 166-168.
- Buknikashvili A, Abuladze A, Edisherashvili G, Kandaurov A, Bekoshvili D, Natradze I (2013) Terrestrial mammals of Borbalo mountain massif and their conservation problems. Lasha Khvichia, Tbilisi, 58 pp. [In Georgian].
- Eukidze G (1951a) Materials for the researches of bioecology of the Libyan jird (*Pallasiomys erithrourus* Gray) in Samgori steppe conditions. Proceedings of the Institute of Zoology of the Georgian Academy of Sciences 10: 83-92. [In Georgian].
- Eukidze G (1951b) Vertebrate fauna of Samgori steppe and its seasonal variability. Proceedings of the Institute of Zoology of the Georgian Academy of Sciences (10)75-82. [In Georgian].
- Eukidze G (1958) Mammals and birds of the plains and mountain slopes forests of the Alazni River basin. Proceedings of the Institute of Zoology of the Georgian Academy of Sciences 16: 107-136. [In Georgian].
- Eukidze G, Sikharulidze Z, Negmedzyanov V (1977) Materials to knowledge on vertebrata of Kintrishi State Reserve. The Nature Protection of Georgia (Article Collection). 5. Metsniereba, Tbilisi, 247-277 pp. [In Georgian].
- Eukidze G, Zarqua G (1985) Distribution of the Transcaucasian, Altai, and Telet squirrels and some issues of their interrelations in Georgia. Reports of Second Scientific Session of the Georgian Branch of All-Union Theriological Society. Second Scientific Session of the Georgian Branch of All-Union Theriological Society, Tbilisi, 17-18 November 1985. Tbilisi, 15-16 pp. [In Georgian].
- Grigoryeva O, Kandaurov A, Stakheev V, Balakirev A, Badtiev A, Magomedov M, Krivonogov D, Andreychev A (2016) Phylogeography and taxonomy of the dormouse

- Dromys nitedula* (Gliridae, Rodentia) Russian plain and the Caucasus. Theriofauna of Russia and Adjacent Territories. Theriofauna of Russia and Adjacent territories and 10th Congress of Russian Theriological Society Russian Academy of Sciences, Moscow, 1-5 February 2016. KMK Scientific Press Ltd, Moscow, 93 pp. [In Russian]. [ISBN 978-5-9907572-8-8].
- Gldenstdt J (1791) Reisen durch Rußland und im Caucasischen Gebirge, Auf Befehl der Russisch-Kayserlichen Akademie der Wissenschaft von P. S. Pallas. 2. Russische Akademie der Wissenschaft, St. Petersburg, 552 pp.
 - Herbreteau V, Jittapalapong S, Rerkamnuaychoke W, Chaval Y, Cosson J, Morand S (2011) Protocols for field and laboratory rodent studies. Retrieved from CERoPath project. Kasetsart University Press. URL: http://www.ceropath.org/FichiersComplementaires/Herbreteau_Rodents_protocols_2011.pdf
 - Jaarola M, Martnkov N, Gndz I, Brunhoff C, Zima J, Nadachowski A, Amori G, Bulatova N, Chondropoulos B, Fragedakis-Tsolis S, Gonzlez-Esteban J, Jos Lpez-Fuster M, Kandaurov A, Kefeliolu H, da Luz Mathias M, Villate I, Searle J (2004) Molecular phylogeny of the speciose vole genus *Microtus* (Arvicolinae, Rodentia) inferred from mitochondrial DNA sequences. Molecular phylogenetics and evolution 33 (3): 647-63. <https://doi.org/10.1016/j.ympev.2004.07.015>
 - Kandaurov A (1995) Two species of the genus *Mus* in Georgia. In: Rynnikov V (Ed.) RAT-Info. State of the Theriofauna in Russia and Adjacent Territories, Moscow, 3-5 February 1995. RAT (PT) of V.Rynnikov, Moscow RAT-Info, 1 (13), 8-9 pp. [In Russian].
 - Kandaurov A, Tskhadaya E (2014) Zoological collections of the Institute of Zoology of the Ilia State University (Georgia). In: Zagorodniuk I (Ed.) Zoological Collections and Museums (Collection of scientific articles). Akademperiodika - Ukrainian Academy of Sciences, Kyiv, 156 pp. [In Russian]. [ISBN 948-966-02-7388-7].
 - Kandaurov A, Tskhadaia E, Begelauri K (2015) Zoological collections of Institute of Zoology of Ilia State University. Proceedings of the Institute of Zoology 24: 123-132. [In Georgian].
 - Kokhia S (1950) Materials for the study of the biology of the Kartli vole (*Microtus socialis goriensis* Argyropulo). Proceedings of the Institute of Zoology of the Academy of Sciences of the Georgian SSR 9: 21-36. [In Georgian].
 - Kokhia S (1956) Focal habitats and their role in the life of the social vole. Proceedings of the Institute of Zoology of the Academy of Sciences of the Georgian SSR 15: 219-241. [In Georgian].
 - Kokhia S (1958) The rodentofauna of the Alazani River basin. Proceedings of the Institute of Zoology of the Academy of Sciences of the Georgian SSR 16: 87-105. [In Georgian].
 - Kokhia S (1960) Biology of the Steppe Mouse (*Mus musculus tataricus* Sat.) in conditions of Kakheti. Proceedings of the Institute of Zoology of the Academy of Sciences of the Georgian SSR 1: 131-149. [In Georgian].
 - Kokhia S (1961) Materials on rodentofauna of health resort Lebarde vicinities'. Proceedings of the Institute of Zoology of the Academy of Sciences of the Georgian SSR 18: 213-216. [In Georgian].
 - Kokhia S (1967) Biology and economic importance of are (*Lepus europaeus* Pall.) in Eastern Georgia. In: Cholokava A (Ed.) Series - Materials on the Fauna of Georgia. Vol. 2. Metsniereba, Tbilisi, 101-129 pp. [In Georgian].

- Kokhia S (1968) The Social vole (*Microtus socialis* Pallas) in Georgia. Metsniereba, Tbilisi, 150 pp. [In Georgian].
- Kokhia S (1974a) Distribution and population density of the hare (*Lepus europaeus* Pall.) In Western Georgia. In: Cholokava A (Ed.) Series - Materials on the Fauna of Georgia. Vol. 4. Metsniereba, Tbilisi, 333-357 pp. [In Georgian].
- Kokhia S (1974b) Distribution and population density of the hare (*Lepus europaeus* Pall.) in the Lesser Caucasus in Georgia. In: Cholokava A (Ed.) Series - Materials on the Fauna of Georgia. Vol. 4. Metsniereba, Tbilisi, 360-383 pp. [In Georgian].
- Kotenkova E (2002) Hybridization of commensal species of house mice and its role in their evolution. *Uspekhi sovremennoĭ biologii* 122 (6): 580-596. [In Russian].
- Kotenkova E, Ambarian A, Kandaurov A, Meshkova N (2016) Exploratory behaviour and response to olfactory cues by the *Mus musculus* species group: implications for the origins of Transcaucasian forms of *Mus*. In: Singleton G, Hinds L, Krebs C, Spratt D (Eds) *Rats, Mice, and People: Rodent Biology and Management*, ACIAR Monograph. 90. Australian Centre for International Agricultural Research, Canberra, 564 pp. [ISBN 1 86320 357 5].
- Kryštufek B, Vohralik V (2005) *Mammals of Turkey and Cyprus: Rodentia I: Sciuridae, Dipodidae, Gliridae, Arvicolinae*. Vol. 1. University of Primorska, Science and Research Centre Koper, Ljubljana, 292 pp. [ISBN 961-6033-60-3]
- Kryštufek B, Vohralik V (2009) *Mammals of Turkey and Cyprus. Rodentia II: Cricetinae, Muridae, Spalacidae, Calomyscidae, Capromyidae, Hystricidae, Castoridae*. Vol. 2. University of Primorska, Science and Research Centre Koper, Ljubljana, 372 pp. [ISBN 978-961-6732-11-6]
- Kumar S, Stecher G, Li M, Knyaz C, Tamura K (2018) MEGA X: molecular evolutionary genetics analysis across computing Platforms. *Molecular Biology and Evolution* 35 (6): 1547-1549. <https://doi.org/10.1093/molbev/msy096>
- Kurashvili B, Rodonaya T, Matsaberidze G, Kakulia G, Eliava I, Ramishvili N, Mikeladze L, Burtikashvili L, Devdariani T, Japaridze L, Petriashvili L (1977) The animal parasites in the vicinity of the Martkopi scientific station. *Parasitology Collection*. Metsniereba, Tbilisi, 51-78 pp. [In Georgian].
- Kurashvili B, Matsaberidze G, Sadikhov I, Rodonaya T (1989) Parasitic worms of small mammals of the Transcaucasian fauna. "Metsniereba", Tbilisi, 196 pp. [In Georgian].
- Lavrenchenko L, Mezhzherin S, Kotenkova E, et al. (1994) *Domovaya mysh': proiskhozhdeniye. rasprostraneniye. Sistematika. Povedeniye*. [House mouse: origin. Distribution. Systematics. Behavior]. Nauka, Moscow, 266 pp. [In Russian]. [ISBN 5-02-004390-7]
- Matsaberidze G (1976) Helminths of micromammals' of Georgia. Metsniereba, Tbilisi, 234 pp. [In Georgian].
- Mittermeier R, Turner W, Larsen F, Brooks T, Gascon C (2011) Global biodiversity conservation: the critical role of hotspots. In: Zachos F, Habel J (Eds) *Biodiversity hotspots*. Springer, Berlin, Heidelberg, 322 pp. [ISBN 978-3-642-20992-5]. <https://doi.org/10.1007/978-3-642-20992-5>
- Morgilevskaya I (1960) On wood mouse from Truso Gorge. *Proceedings of the Institute of Zoology of the Academy of Sciences of the Georgian SSR* 17: 125-129. [In Russian].
- Morgilevskaya I (1974) The taxonomic characteristics of wood mice in Georgia. In: Kokhia S, Cholokava A (Eds) *Series - Materials to the Fauna of Georgia*. Vol. 4. Metsniereba, Tbilisi, 402-457 pp. [In Russian].

- Morgilevskaya I (1989) Katalog kollekciy melkikh mlekopitayuschikh Instituta Zoologii AN GSSR. [The catalogue of the collection of the small mammals of the Institute of zoology of the Academy of sciences of the Georgian SSR]. Metsniereba", Tbilisi, 28 pp. [In Russian].
- Morgilevskaya I, Tskipurishvili D (1989) Lesnaya mysh' v Gruzii (Morfologicheskiy ocherk). [The wood mouse in Georgia, a morphological study]. Metsniereba, Tbilisi, 112 pp. [In Russian].
- Nordmann A (1840) Voyage dans la Russie méridionale et la Crimée, par la Hongrie, la Valachie et la Moldavie, exécuté en 1837, sous la Direction de M. Anatole de Demidoff Observations sur la Faune pontique. [Travel in Southern Russia and the Crimea, through Hungary, Wallachia and Moldavia, executed in 1837, under the Direction of M. Anatole de Demidoff. Observations on the Pontic Fauna]. Ernest Bourdin et C, Paris, 621 pp.
- Ognev S (1940) Zveri SSSR i prilezhashchikh stran (zveri vostochnoy Yevropy i severnoy Azii) gryzuny. [Mammals of the USSR and adjacent countries (mammals of Eastern Europe and Northern Asia). Rodents]. Vol. 4. Academy of Sciences of Soviet Union, Moscow-Leningrad, 570 pp. [In Russian]. [ISBN 978-5-4460-1294-7]
- Ognev S (1950) Zveri SSSR i prilezhashchikh stran (Zveri Vostochnoy Yevropy i Severnoy Azii) Gryzuny. [Mammals of the USSR and Adjacent Countries (Mammals of Eastern Europe and Northern Asia). Rodents]. Vol. 7. Academy of Sciences of Soviet Union, Moscow-Leningrad, 706 pp. [In Russian].
- Orth A, Lyapunova E, Kandaurov A, Boissinot S, Boursot P, Vorontsov N, Bonhomme F (1996) L'espece polytypique *Mus musculus* en Transcaucasie. Comptes Rendus de l'Academie des Sciences, Paris, Sciences de la vie 319: 435-441. [In French].
- Pallas P (1811) Zoographia Rosso-Asiatica: sistens omnium animalium in extenso Imperio Rossico, et adjacentibus maribus observatorum recensionem, domicilia, mores et descriptions, anatomen atque icons plurimorum. [Zoographia Rosso-Asiatica: Containing review of all the animals observed in the extended Empire of Russia, and in the Adjacent Seas, their habitats, habits and descriptions, the anatomy and icons of most of them]. Vol. I. In officina Caes. Academiae Scientiarum Impress, Petropoli, 568 pp. [In Latin].
- Papava A (1940) On the finding of the Transcaucasian squirrel in Western Georgia. Priroda (Nature) 3: 82-83. [In Russian].
- Papava A (1953) The key of the mammals of Georgia. Science-Methodical Office (Nauchno-Metodicheskiy Kabinet), Tbilisi, 139 pp. [In Georgian].
- Papava A (1955) On the issues of studying the distribution of varieties of the European hare in Georgia. Proceedings of the Staliniri State Pedagogical Institute 2: 63-66. [In Georgia].
- Papava A (1959) On the issue of taxonomy, biology and distribution of some rodents. Proceedings of the Staliniri State Pedagogical Institute 7 [In Russian].
- Papava A (1960) The key of the mammals of Georgia. Tsodna, Tbilisi, 160 pp. [In Georgian].
- Radde G (1899) Die Sammlungen des Kaukasischen Museums, Zoologie. Vol. 1. Typographie der Kanzelei des Landescheffs, Tiflis, 520 pp. [In Russian and German].
<https://doi.org/10.5962/bhl.title.49456>

- Ratnasingham S, Hebert P (2007) Barcoding: the barcode of life data system (<http://www.barcodinglife.org>). *Molecular Ecology Notes* 7 (3): 355-364. <https://doi.org/10.1111/j.1471-8286.2007.01678.x>
- Rodonaia T (1956) Helminth fauna of wild mammals of the Lagodekhi State Reserve. *Proceedings of the Institute of Zoology of the Academy of Sciences of Georgia* 16: 147-187.
- Sagdieva P, Kandaurov A (1985) To study bloodsucker ticks of rodents of Greater Caucasus. *Metsniereba. Paper Collection of the Fourth Transcaucasian Workshop on Parasitology* [Russian].
- Sagdieva P, Kandaurov A, Voltsit O (2002) Ticks (Parasitiformes, Ixodidae) of small mammals in Georgia. *Proceedings of the Institute of Zoology of the Academy of Sciences of Georgia* 21: 103-107.
- Satunin K (1898) About the mammals of the Caucasus [O Mlekopitayushchikh Kavkaza]. *Diary of the Zoological Department of the Imperial Society of Lovers of Natural Science, Anthropology and Ethnography* [Dnevnik Zoologicheskogo Otdela Imperatorskogo Obshchestva Lyubiteley Yestestvoznaniya, Antropologii i Etnografii] 2 (9-10). [In Russian].
- Satunin K (1903) Review of the study of mammals of the Caucasian region. *Notes of the Caucasian Department of the Russian Geographical Society* 24 (2): 2-63. [In Russian].
- Satunin K (1908) First extension to the list of mammals of the Caucasus region. *Notes of the Caucasian Department of the Imperial Russian Geographical Society* 26 (4): 30. [In Russian].
- Satunin K (1909) Materials for the knowledge of mammals of the Caucasus and the Trans-Caspian region. *Proceedings of the Caucasian Museum* 4 (1-2): 269-300. [In Russian].
- Satunin K (1912) On the zoogeographic districts of the Caucasus region. Preliminary communication. *Proceedings of the Caucasian Museum* 7 (1): 7-55. [In Russian].
- Satunin K (1913) Fauna of the Black Sea coast of the Caucasus. *Mammals. Proceedings of the Society for the Study of the Black Sea Coast* 2: 248. [In Russian].
- Satunin K (1920) *Mammals of the Caucasian Land. Travaux de Museum de Georgie. Tiflis* 2: 223. [In Russian].
- Sayers EW, Cavanaugh M, Clark K, Pruitt KD, Schoch CL, Sherry S, Karsch-Mizrachi I (2021) GenBank. *Nucleic Acids Research* 50 <https://doi.org/10.1093/nar/gkab1135>
- Sheffel B (2018) Methods for estimating the abundance of small mammals. *Russian Journal of Ecosystem Ecology* 3 (3): 1-21. [In Russian]. <https://doi.org/10.21685/2500-0578-2018-3-4>
- Shidlovskiy M (1919a) Material on the fauna of Transcaucasia. Part 2. Microtinae. 2. Subgenus *Chionomys* Miller. *Proceedings of the Zemstvo Station for the Rodent Control in the Transcaucasia* 5: 38. [In Russian].
- Shidlovskiy M (1919b) Materials on the fauna of Transcaucasia. Part 1. Microtinae. 1. Subgenus *Arbustisola*. *Proceedings of the Zemstvo Station for the Rodent Control in the Transcaucasia* 2: 46. [In Russian].
- Shidlovskiy M (1938) About the *Arbusticola* Group. *Proceedings of the Simon Janashia State Museum of Georgia* 9: 80-100. [In Russian].
- Shidlovskiy M (1940a) New data on the rodent fauna of Georgia. *Proceedings of the Georgian Branch of the Academy of Sciences of USSR* 1 (2): 143-148. [In Russian].

- Shidlovskiy M (1940b) Peculiarities of the distribution of the Transcaucasian hamster (*Mesocricetus brandti* Nehr) along the Caucasian Isthmus. Zoological collection, Armenian Branch of Academy of Sciences of the USSR. 2. Yerevan, 37-46 pp.
- Shidlovskiy M (1941a) Opredelitel' gryzunov Gruzii i sopredel'nykh stran. [The key to the rodents of Georgia and adjacent countries]. Academy of Sciences of the Georgian SSR, Tbilisi, 55 pp. [In Russian].
- Shidlovskiy M (1941b) Characteristic features of the rodents' fauna of Georgia. Communications of the Academy of Sciences of the GSSR 2 (1-2): 137-144. [In Russian].
- Shidlovskiy M (1945) Relict and endemic species in rodent fauna of Georgia. Proceedings of the Institute of Zoology of the Academy of Sciences of the Georgian SSR 6: 431-439. [In Russian].
- Shidlovskiy M (1947a) Rodent fauna of Georgian Black Sea coast. Proceedings of the Institute of Zoology of the Academy of Sciences of the Georgian SSR 7: 97-146. [In Russian].
- Shidlovskiy M (1947b) Taxonomy of the Transcaucasian squirrel. Second Scientific Session of Institute of Zoology of Academy of Sciences of Armenia SSR25-26. [In Russian].
- Shidlovskiy M (1948) Rodents of Adjaria (ecological-faunistic review) [Gryzuny Adzharii]. Proceedings of Academy of Science of Georgian SSR 8: 187-223. [In Russian].
- Shidlovskiy M (1950) Rodents of Abkhazia (ecological-faunistic Review). Proceedings of the Institute of Zoology of the Academy of Sciences of the Georgia SSR 9: 135-161. [In Russian].
- Shidlovskiy M (1951) Rodents of South-Osetia (ecologic-faunistic Review). Proceedings of the Institute of Zoology of the Academy of Sciences of the Georgia SSR 10: 187-222. [In Russian].
- Shidlovskiy M (1953) Broad-toothed mouse *Silvimus mystacinus* (Danford et Alston) in rodent fauna of Georgia (Rodentia, Muridae). Proceedings of the Institute of Zoology of the Academy of Sciences of the Georgia SSR 12: 135-168. [In Russian].
- Shidlovskiy M (1954a) On the systematics and distribution of the fat dormouse (*Glis glis* Linn.) in Georgia (Rodentia, Myoxidae). Proceedings of the Institute of Zoology of the Academy of Sciences of the Georgia SSR 13: 47-61. [In Russian].
- Shidlovskiy M (1954b) Family of gerbils in the rodent fauna of Georgia (Rodentia, Gerbillidae). Proceedings of the Institute of Zoology of the Academy of Sciences of the Georgia SSR 13: 63-69. [In Russian].
- Shidlovskiy M (1956) On the systematics and distribution of the forest dormouse (*Dryomys nitedula* Pall.) in Georgia. Proceedings of the Institute of Zoology of the Academy of Sciences of the Georgia SSR 14: 249-259. [In Russian].
- Shidlovskiy M (1964) The Great Caucasus high mountain mammal fauna in Georgia. In: Kobakhidze D (Ed.) The Great Caucasus high mountain fauna. Tbilisi, 175-198 pp.
- Shidlovskiy M (2013) Rodents of Georgia - faunistic structure and ecological-geographical spreading. In: Bukhnikashvili A, Kandaurov A (Eds) The Materials for the Fauna of Georgia (1948). Vol. 5. Lasha Khvichia, Tbilisi, 1-62 pp. [In Russian]. [ISBN 978-9941-0-5377-1].
- Shidlovskiy M (1976) Opredelitel' gryzunov Zakavkaz'ya. [The key to the rodents of the Transcaucasia]. Second Edition. Metsniereba, Tbilisi, 255 pp. [In Russian].

- Tskhadaia E, Begelauri K, Kandaurov A (2019) Geographical coverage of the collection of the Institute of Zoology of Ilia State University. In: Zagorodnyuk I (Ed.) Natural History Museums in Ukraine: Formation and Prospects for Development. Natural History Museums in Ukraine: Formation and Prospects for Development, Kyiv, 7-8 October 2019. National Academy of Sciences of Ukraine; National Museum, of Natural History, Kyiv Natural History Museology, 5, 231-235 pp. [ISBN 978-966-02-8999-4, 978-966-02-8997-0].
- Ukleba D (1981a) Landscapes. In: Abashidze I (Ed.) Georgian Soviet Encyclopedia Volume Georgian SSR. Main scientific editorial, Tbilisi, 27-28 pp.
- Ukleba D (1981b) Physical-geographical zoning [pizik'ur-geograpiuli daraoneba]. In: Abashidze I (Ed.) Georgian Soviet Encyclopedia, Volume of Georgian SSR. Main Scientific Editorial, Tbilisi, 28-30 pp. [In Georgian].
- Verestchagin N (1959) Mlekopitayushchiye Kavkaza. [The mammals of the Caucasus]. Academy of Sciences of the USSR, Leningrad, 703 pp. [In Russian].
- Vorontsov N, Boyeskorov G, Mezhzherin S, Lyapunova E, Kandaurov A (1992) Systematics of the Caucasian wood mice of the subgenus *Sylvaemus* (Mammalia, Rodentia, *Apodemus*). Russian Journal of Zoology 71: 119-131. [In Russian].
- Yanchukov A, Kandaurov A, Şahin M, Matur F (2020) Karyotype analysis of *Nannospalax xanthodon* (Spalacidae, Rodentia) at the easternmost part of its distribution range. Communications Faculty of Sciences University of Ankara, Series C Biology 29 (1): 61-70.
- Zazanashvili N, Sanadiradze G, Garforth M, Bitsadze M, Manvelyan K, Askerov E, Mousavi M, Krever V, Shmunk V, Kalem S, Devranoğlu Tavsel S (Eds) (2020) Ecoregional Conservation Plan for the Caucasus: 2020 Edition. Fountain Georgia LTD. WWF, KfW, Tbilisi.