Dragonfly Fauna (Insecta: Odonata) from Romania

PhD Thesis Abstract

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Cluj-Napoca, 2012

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Content

Keywords:
Odonata, dragonflies, Romania, biodiversity, distributions

Introduction

Odonata order comprises over 5800 known species (Schorr & all, 2012). From these, in Romania can be found aproximately 71 species and subspecies from a total of 120 species in Europe (Dijkstra, 2006).

The representatives of the order are commonly known as „dragonflies", term with which we will also name the group representatives in the following thesys.

Concentrated exclusively on the study of dragonflies on the Romanian territory, this paper is one of the most complete works from the last years on the distribution of the species in our country. It has a high potential through the plans of becoming a complete monography strictly for Romanian territory.

To show the distribution data found in literature has been used, these data having over 100 years, data from museum collections in Romania (still unpublished), data from third parties (pictures or samples collected) and of course personal data collected from the last 15 years. All these data (literature, collections, personal observations or from other sources) are represented on maps.

Chapter 2

Odonata order – a general part

Research history for Romanian territory

The first research on dragonflies on Romanian territory (Cârdei şi Bulimar, 1965) began in the last century, when, Fuss C. in 1853 and 1855 published a list of dragonflies, together with other insects, from Transylvanian territory, more precisely the surroundings of Sibiu (*Notizen und Beiträge zur Insectenfauna Siebenbürgens*, *Beitrag zur Insectenfauna Siebenbürgens*). In 1854, Czeckelius D. Published a paper in which he reffers to the dragonflies from Transylvanian territory (*Die Verbreitung der Salzquellen und des Steinsalzes in Siebenbürgen)*, and in 1876, R.Kohaut published in Budapest a first exclusive paper on dragonflies (*A magyarsági szitakötőfélek Természetrajza)* which lists 28 species for central Transylvania.

After this beginning, the research is continued by D. Czeckelius in Transylvania. The first references for Ţara Românească region are made in 1898 by Lachlan R. Mac. In 1905 there are new data on dragonflies, especially in Moldova and Dobrogea, these contributions being made by Kempny P. and Montadon A.L. and in 1910, a paper by E. Petersen is published and in 1918, Mocsary A. publishes a list of 30 species from Banat and Dobrogea regions.

A new era in dragonfly research for Romania started in 1949 thanks to Cârdei F., who published numerous works with new sistematic and biogeographic datas. These researches culminate in 1965, when, together with Bulimar F., he publishes the dragonfly monography for Romania. Numerous other researches on dragonflies are made by F. Bulimar who publishes various works until 1996. Other papers are published starting 1956 by M.A.

Ienişţea, J. Adamovici, Fr. Pór, H. Plattner, A. Popescu-Gorj and others. In Banat region the research on this group are quite disparate, in general being limited to southern Banat in particular Băile Herculane area (Dumont H. în 1977; Beutler H. în 1988).

Life cicle

Dragonflies are insects with an incomplete metamorphosis, their life cicle including the following stages: egg, larvae and adult, lacking the pupa stage. With very few exceptions, the larvae are aquatic. They are also known under the common names of naiad or nymphs.

The egg

Egg laying usually occurs in water, directly into the water mass or in plant tissues which are in general underwater. In theese plant tissues galas can form, well known phenomenon especially for the species *Lestes viridis*. At laying, the eggs are of a white clear color. They later change color and become brown. Egg hatching usually takes place two weeks after at *Zygoptera* and up to four weeks for *Anisoptera*. Exceptions are the eggs entering diapause, stage in which they pass the winter.

Larvae: biology and development

The larvae hatch from eggs with the help of a throbbing organ called cephalothorax heart, organ which exists from few seconds up tp few minutes. Hatching occurs after a stimulus: a stimulus example being exposure to water of the deposited eggs above the water (usually spring with the rising of water level) or an increase in water temperature (Cârdei & Bulimar, 1965).

The larvae, like adults, are carnivorous, feeding on almost any small animals, sometimes even bigger than them. Dragonfly larva captures prey with a special organ - a specialized prehensile labium (Fig. 1). It can be extended with very high speed (total extension takes about 15-20 milliseconds). The labium consists of mentum and submentum that are articulated. The mentum (the distal part) has the palps transformed into hooks used to grasp prey.

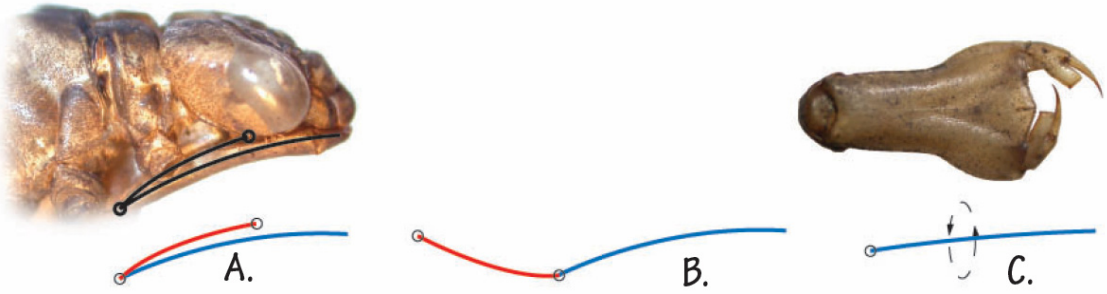

Fig. 1. Labium of *Aeshna affinis* (submentum in red, mentum in blue). A. Labium in resting position. B. Labium at maximum extension. C. The mentum in ventral view to observ the palps transformed in hooks. (orig.)

The larvae, in its development, passes through a number of 10 to 15 sheddings (usually 12-13) (Corbet, 2004), sheddings that succeed faster in warmer months and when food is abundant. The last larvae stage suffers some changes (before the last „transformation"), thus, its color becomes darker, the eye color more intense, the mask starts to regress, the feeding stops, they frequent the places with shallow water, climb on shore or on vegetation, the respiratory activity is more intense the larvae partially exiting from the water for more oxygen necessary to the following metamorphosys. All these changes are controlled by hormones (Wigglesworth, 1984; Corbet, 2004).

Adult emergence

The final stage larvae leave water, climbing on shore or on near vegetation, in the search of an appropiate spot where the final shedding can take place (the emergence of the adult) (fig. 2). The entire process lasts between 30 and 120 minutes. Întregul proces durează între 30 şi 120 de minute. Fast water species are characterized by a faster metamorphosys. The wings are slowly strenghten over several hours.

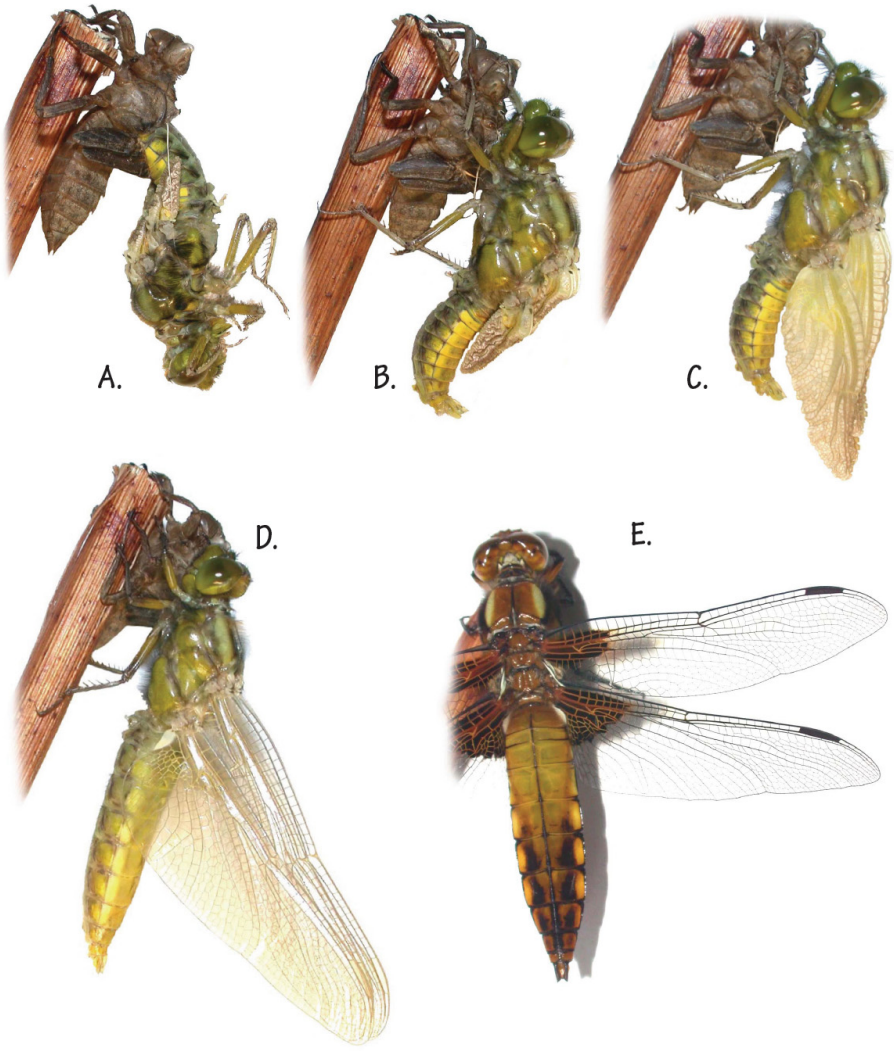

Fig. 2. Adult emergence for *Libellula depressa* (orig.)

The study of dragonflies – Research and collecting methods

Collection and preservation of dragonflies is indispensable for research. For the material collected to have scientific value is necessary that each specimen collected to have the datas of collection. Are of high importance the datas on habitat: altitude, longitude, latitude, about water (depth, if running or not, and if possible some data on water chemistry), aquatic plants found on site and the related behavioral data to be recorded whenever possible.

Collecting and conserving larvae

Larvae are collected from water with aquatic nets and after collection, it is best that the larvae are kept moist until laboratory.

In the laboratory larvae are placed in boiling water for about 30 seconds and than placed in alcohol of 70% concentration. The *Zygoptera* larvae are directly introduced in alcohol of 70% concentration.

Collecting and conserving exuviae

Exuviae (fig. 3) can be found on the water banks on various supports. Their study is important becuase they are the only proof of the species presence (reproducing) at the site. Collected exuviae can pe kept on entomological pin and in alcohol.

Fig. 3. *Libellula depressa* exuvia - Bezdin, jud. AR, 15.V.2005 (orig.)

Colectting and conserving adults

The dragonfly adult collecting is done with entomological net and after capturing, the adults are introduced head first in paper envelopes. After returning from the field, in laboratory, the envelops with specimens are subjected to a treatment with acetone. The acetone treatment is considered to be the best method of preserving odonatas, resulting in better color rettention. In addition to preserving colors this treatment is essential for high ambient humidity areas (tropical areas situation / equatorial) for, following the treatment the material dries almost instantly. In acetone, the envelopes are held for 12-24 hours depending on dimension.

After the envelopes were removed from the acetone they are left dry for several days in the sun and in well-ventilated spaces. After drying the specimen permanent storage is done in transparent envelopes, usually plastic. Personally, I opted for Ziploc plastic envelopes because they provide a good isolation of each specimen against various collection pests (Fig.36). In the respective envelope a label will data collection shall be introduced. Envelopes are stored upright, as a business card, in boxes.

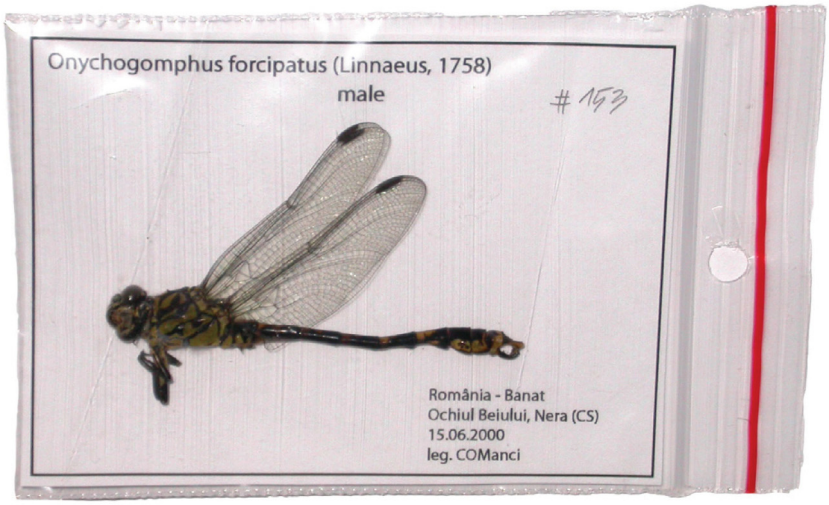

Fig. 4. *Onycogomphus forcipatus* specimen in collection (orig.)

Observing the adults

Much of the data of this paper is based on observations, that at the expense of collecting. For this I created a data sheet for the field that contains all species from Romania and those who present potential to be found in the future. On these data sheets one takes notes according to the table. When there were doubts in determining the biological material was collected and photographed in order to be analyzed in laboratory.

Habitats and species

The Odonata species are closely related to aquatic habitats (lentic or lotic) and each species or family has a preference for one or another of them.

Of 9 families, 5 families of dragonflies (Lestidae, Coenagrionidae, Aeshnidae, Corduliidae and Libellulidae) have special preferences for lentic habitats (still waters) and 4 (Calopterygidae, Platycnemididae, Cordulegastridae and Gomphidae) for lotic habitats (running waters) (Fig. 5).

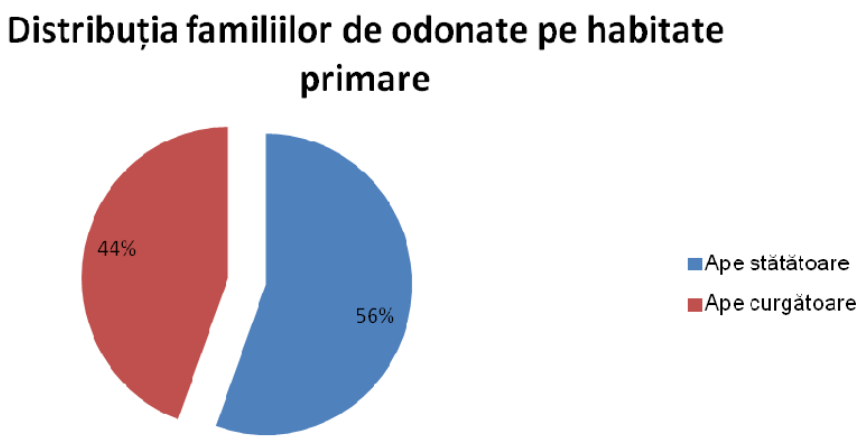

Fig. 5. The percentual distribution of odonata families in primary habitats

At a specific level, of the 69 species from Romanian fauna, only 10 species are typical for running water habitats and most species are found in stagnant waters (fig. 6).

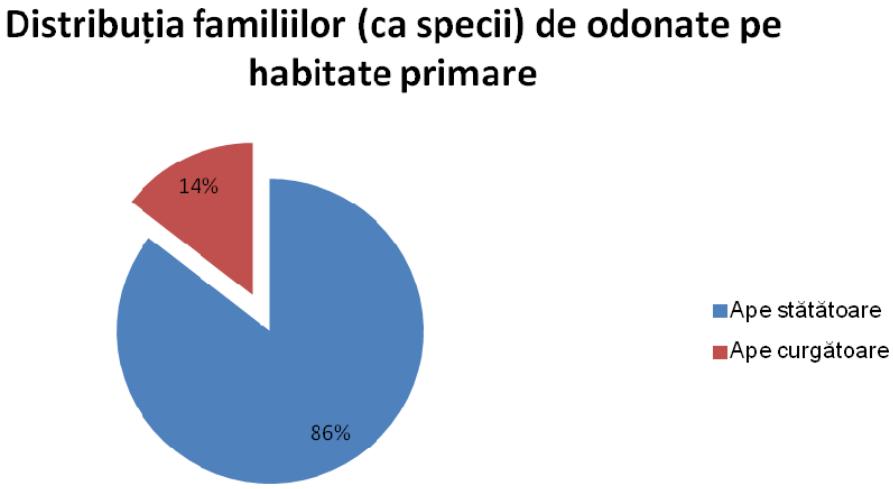

Fig. 6. The percentual distribution of odonata families in primary habitats

Main ecosystems characterized by specialized species are alpine lakes, bog and salt lakes (or coastal).

The lakes in alpine areas (Fig. 7) may have a very large fauna as number of individuals but extremely poor in species when these present a eutrophic abundant vegetation.Their characteristic species are *Aeshna juncea* and *Somatochlora alpestris*. It is considered that these habitats are extremely vulnerable to the impact of global warming (The Knijf & all, 2011).

Fig. 7. Alpine lake in Căldarea Bucurei (Retezat Mountains), July 2009 (orig.)

Bogs have, depending on the altitude they are situated and surface of water open, a very different fauna. The bogs at high altitude (Fig. 9) in the coniferous forests areas, are characterized by a rich fauna in specimen number, but a small number or relatively small of species. Those with larger open water surface have more species and those with more aquatic vegetation less species. Among the interesting species that can be seen in bogs are: *Somatochlora alpestris*, *Somatochlora arctica*, *Aeshna juncea*, *Aeshna subarctica*, *Leucorrhinia dubia*. These habitats are also considered extremely vulnerable to the impacts of climate change.

Fig. 8. Bog in high altitude area (Apuseni Mountains), July 2009 (orig.)

In bogs at a lower altitude, dragonfly fauna can be very diverse, like that of lakes, if there are surfaces of open water. Where the open water surface is almost absent, you can observe the species *Nehalennia speciosa*.

This species was considered extinct in the Romanian fauna (Bernard &Wildermuth, 2005) but in 2009 was rediscovered in Romania.

The salt lakes (or coastal) can have a rich fauna species. These are usually adapted to temporary habitats. A strictly related species to these habitats is *Lestes macrostigma*.

Practicality of the ecological studies, case study for *Calopteryx* in Romania

The correspondence habitat / environmental feature can be used in practice to create theoretical models for the distribution of one or more taxa such that an algorithm for a theory of spatial distribution pattern was created and used for two species (*Calopteryx virgo* and *Calopteryx splendens*), bellow the model for Calopteryx virgo (Fig. 9).

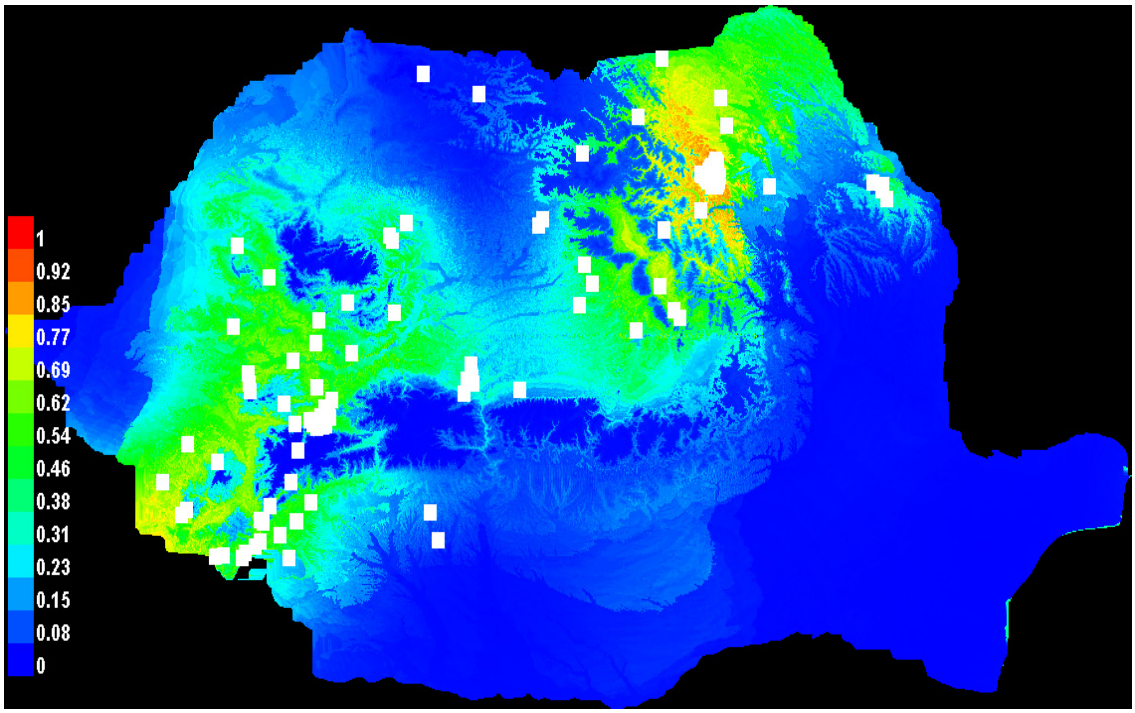

Fig. 9. Potential distribution for *Calopteryx virgo*, realized with the help of MaxEnt application

The status of two boreo-alpine *Somatochlora* (*S. arctica and S. alpestris*) species from Romania and their vulnerability due to climate changes

The topic regarding the two species was discussed in detail in the paper "*The status of two boreo-alpine species, S. alpestris and Somatochlora arctica in Romania and their vulnerability to the impact of climate change (Odonata: Corduliidae)*" (De Knijf & all, 2011). In the following we will just point out some ideas.

Among the conclusions:

- ✓ Analyzed data is viewed only in terms of presence / absence and altitude, using the GLM and GAM statistical methods. The species were observed only between 1360 and 2050 m altitude and *Somatochlora arctica* was found only at 1360 and 1380 m;
- ✓ For *Somatochlora alpestris* species, using only the altitude factor, a model to predict the presence/absence was developed for Meridional Carpathians; Because the alpine species are exposed to the impact of global warming two models of potential distributions were developed for the cases where the average temperature increases with 1.5°C and a relocation is made for species populations of 100 m in altitude for each 0.7°C - this scenario resulting in a reduction of distribution by 41% (fig. 10) or the average temperature increases with 3°C and a relocation is made of species populations with 100 m altitude for every 0.5°C - this scenario resulting in a reduction of distribution by 91%.

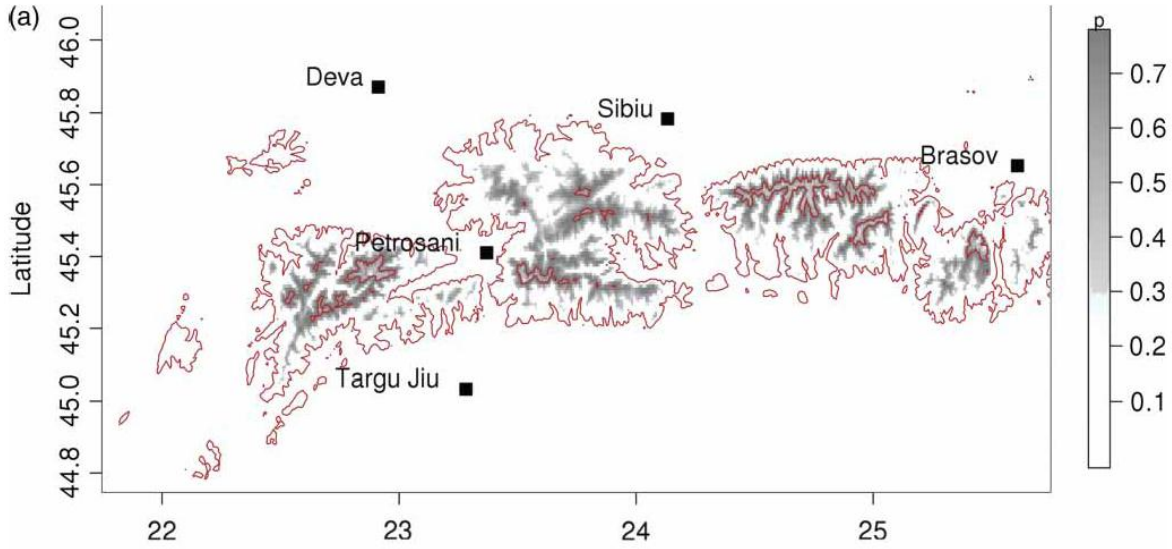

Fig. 10. Potential distribution scenario of *Somatochlora alpestris* species in which the average temperature increases with 1,5°C and a relocation of the species is made with 100 m on altitude for each 0,7°C , red contour lines represent elevations of 1000 and 2000 m (din De Knijf & all, 2011)

Chapter 3
Odonata Order – systematic part
Systematic list of species from Romania

Next, Romanian Odonata fauna is treated in terms of ecology, species by species. Also, each species is illustrated and its national distribution is presented. Distribution is shown by red or blue dot. The red dot represents data from literature before 1979 when the paper "*Sinteze cartografice ale patrimoniului natural al României*" (Lehrer & Bulimar, 1979) was published, this being the last paper that summarizes data for national distribution of dragonflies. The blue dots represent distribution data of indexed papers which appeared after 1979 and from personal datas. Of about 6,500 entries in the database, about 4500 are personal data. The maps have been generated with specific web applications that are included in the resource toolkit of Nature Digital Object Repository at **http://mybiosis.info/**, courtesy of Dr. Adorian Ardelean.

In the following a critical list of species in Romania is given, with the mentions:

- ✓ The species marked with (*) are possible to occur in Romania;
- ✓ The species marked with (**) are signaled from Romania but, their known distribution excludes their presence in the country no new data being found in papers, citations or collections;
- ✓ The species marked with (***) are species recently certenly signaled on the country's territory.

ZYGOPTERA

Calopterygidae

Calopteryx Leach, 1815
Calopteryx splendens (Harris, 1782)
Calopteryx virgo (Linnaeus, 1758)

Euphaeidae

Epallage Charpentier, 1840
Epallage fatime (Charpentier, 1840) (*)

Lestidae

Lestes Leach, 1815
Lestes barbarus (Fabricius, 1798)
Lestes dryas Kirby, 1890
Lestes macrostigma (Eversmann, 1836)
Lestes parvidens Artobolevsky, 1929 (***)
Lestes sponsa (Hansemann, 1823)
Lestes virens (Charpentier, 1825)
Lestes viridis (Vander Linden, 1825)

Sympecma Burmeister, 1839
Sympecma fusca (Vander Linden, 1820)
Sympecma paedisca (Brauer, 1882) (*)

Coenagrionidae

Ceriagrion Selzs, 1876
Ceriagrion tenellum (de Villers, 1789) (**)

Coenagrion Kirby, 1890
Coenagrion armatum (Charpentier, 1840)
Coenagrion caerulescens (Fonscolombe, 1838) (**)
Coenagrion hastulatum (Charpentier, 1825)
Coenagrion lunulatum (Charpentier, 1840)
Coenagrion mercuriale (Charpentier, 1840) (**)
Coenagrion ornatum (Selys, 1850)
Coenagrion puella (Linnaeus, 1758)
Coenagrion pulchellum (Vander Linden, 1825)
Coenagrion scitulum (Rambur, 1842)

Enallagma Charpentier, 1840
Enallagma cyathigerum (Charpentier, 1840)

Erythromma Charpentier, 1840
Erythromma lindenii (Selys, 1840)
Erythromma najas (Hansemann, 1823)
Erythromma viridulum (Charpentier, 1840)

Ischnura Charpentier, 1840
Ischnura elegans (Vander Linden, 1820)
Ischnura pumilio (Charpentier, 1825)

Nehalennia Selys, 1850
Nehalennia speciosa (Charpentier, 1840)

Pyrrhosoma Charpentier, 1840
Pyrrhosoma nymphula (Sulzer, 1776)

Platycnemididae

Platycnemis Burmeister, 1839
Platycnemis pennipes (Pallas, 1771)

ANISOPTERA

Aeshnidae

Aeshna Fabricius, 1775
Aeshna affinis Vander Linden, 1820
Aeshna caerulea (Stroem, 1783) (*)
Aeshna cyanea (Müller, 1764)
Aeshna grandis (Linnaeus, 1758)
Aeshna isoceles (Müller, 1767)
Aeshna juncea (Linnaeus, 1758)
Aeshna mixta Latreille, 1805
Aeshna subarctica Walker, 1908 (***)
Aeshna viridis Eversmann, 1836 (*)

Anax Leach, 1815
Anax ephippiger (Burmeister, 1839)
Anax imperator Leach, 1815
Anax parthenope (Selys, 1839)

Brachytron Evans, 1845
Brachytron pratense (Müller, 1764)

Caliaeschna Selys, 1883
Caliaeschna microstigma (Schneider, 1845) (*)

Gomphidae

Gomphus Leach, 1815
Gomphus flavipes (Charpentier, 1825)
Gomphus pulchellus Selys, 1840 (**)
Gomphus vulgatissimus (Linnaeus, 1758)

Onychogomphus Selys, 1854
Onychogomphus forcipatus (Linnaeus, 1758)
Onychogomphus uncatus (Charpentier, 1840) (**)

Ophiogomphus Selys, 1854
Ophiogomphus cecilia (Fourcroy, 1785)

Cordulegastridae

Cordulegaster Leach, 1815
Cordulegaster bidentata Selys, 1843
Cordulegaster boltonii (Donovan, 1807) (**)
Cordulegaster heros Theischinger, 1979
Cordulegaster picta Selys, 1854 (*)
Cordulegaster insignis Schneider, 1845

Corduliidae

Cordulia Leach, 1815
Cordulia aenea (Linnaeus, 1758)

Epitheca Burmeister, 1839
Epitheca bimaculata (Charpentier, 1825) (***)

Somatochlora Selys, 1871
Somatochlora alpestris (Selys, 1840)
Somatochlora arctica (Zetterstedt, 1840) (***)
Somatochlora flavomaculata (Vander Linden, 1825)
Somatochlora meridionalis Nielsen, 1935 (***)
Somatochlora metallica (Vander Linden, 1825)

Libellulidae

Crocothemis Brauer, 1868
Crocothemis erythraea (Brullé, 1832)
Crocothemis servilia (Drury, 1773) (**)

Leucorrhinia Brittinger, 1850
Leucorrhinia caudalis (Charpentier, 1840) (*)
Leucorrhinia dubia (Vander Linden, 1825)
Leucorrhinia pectoralis (Charpentier, 1825)

Libellula Linnaeus, 1758
Libellula depressa Linnaeus, 1758
Libellula fulva Müller, 1764
Libellula quadrimaculata Linnaeus, 1758

Orthetrum Newman, 1833
*Orthetrum albistylum (*Selys, 1848)
Orthetrum brunneum (Fonscolombe, 1837)
Orthetrum cancellatum (Linnaeus, 1758)
Orthetrum coerulescens (Fabricius, 1798)

Sympetrum Newman, 1833
Sympetrum danae (Sulzer, 1776)
Sympetrum depressiusculum (Selys, 1841)
Sympetrum flaveolum (Linnaeus, 1758)
Sympetrum fonscolombii (Selys, 1840)
Sympetrum meridionale (Selys, 1841)
Sympetrum pedemontanum (Allioni, 1766)
Sympetrum sanguineum (Müller, 1764)

Sympetrum striolatum (Charpentier, 1840) *Sympetrum vulgatum* (Linnaeus, 1758)

From this list of 84 species we can draw the following conclusions:

- ✓ 7 species are possible for Romania being found at relatively small distances (~50 km) from the Romanian borders;
- ✓ The presence of 7 species is questionable due to their geographic area which excludes their presence on the country's territory or are only cited in papers, but with no refference;
- ✓ 5 species are new or reconfirmed as presence on Romania's territory.

The distribution maps of dragonfly species from Romanian fauna

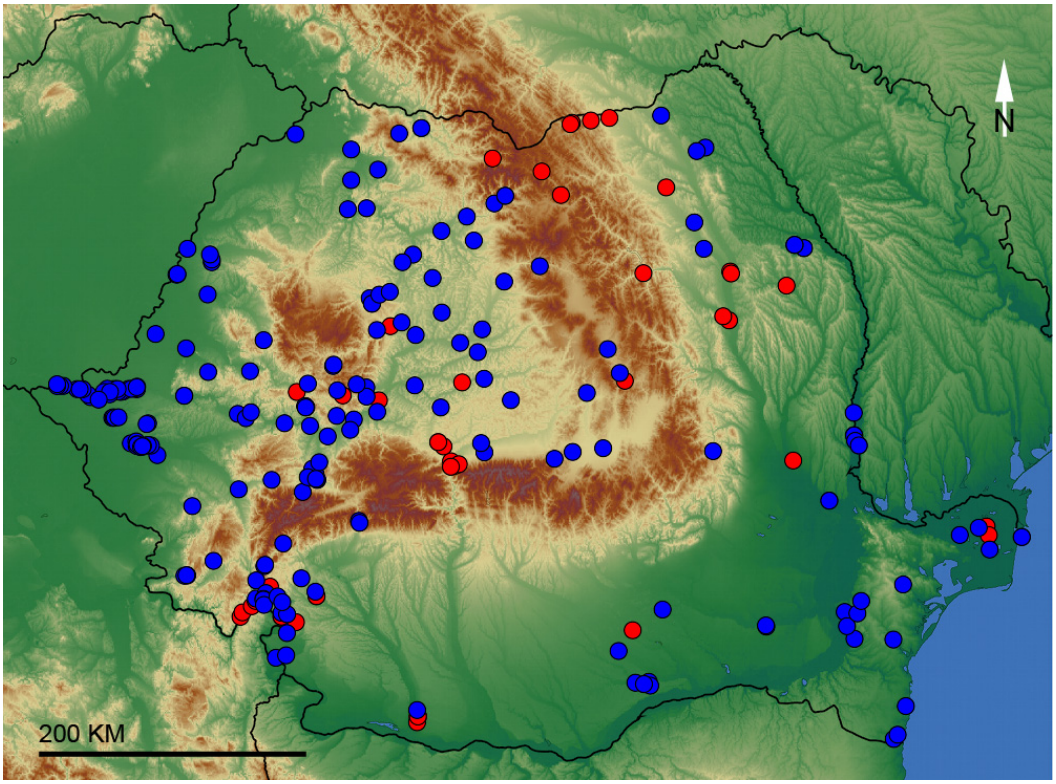

Fig. 11. Distribution map of *Calopteryx splendens*

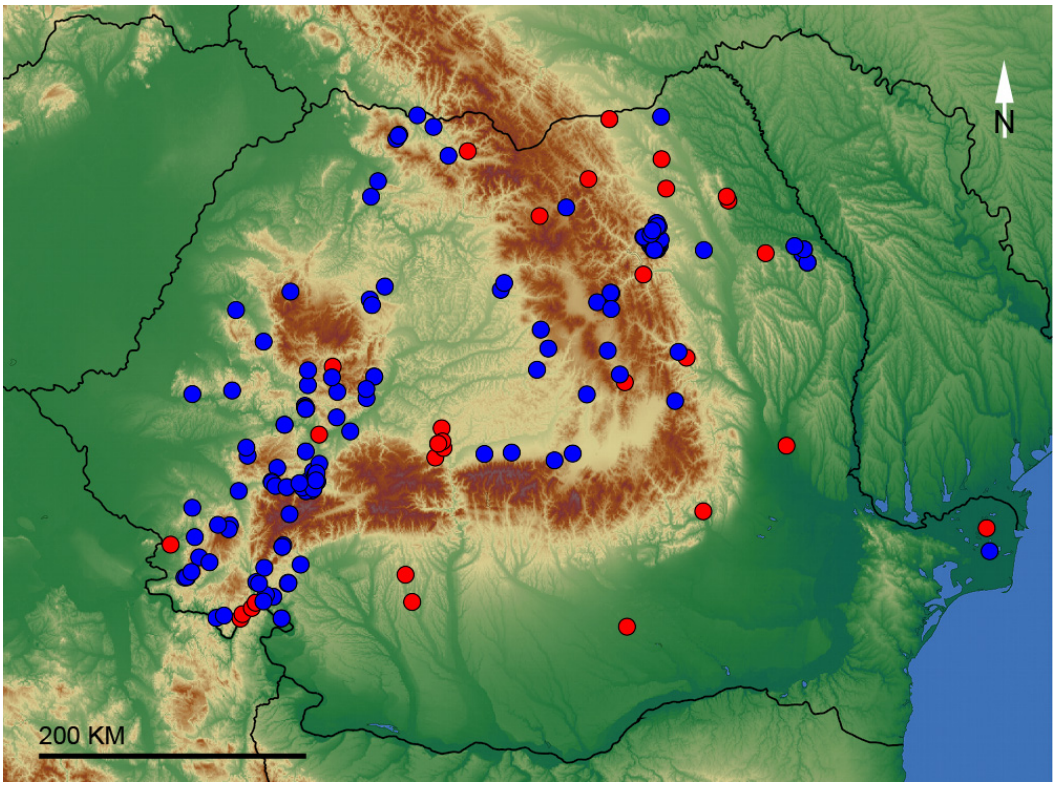

Fig. 12. Distribution map of *Calopteryx virgo*

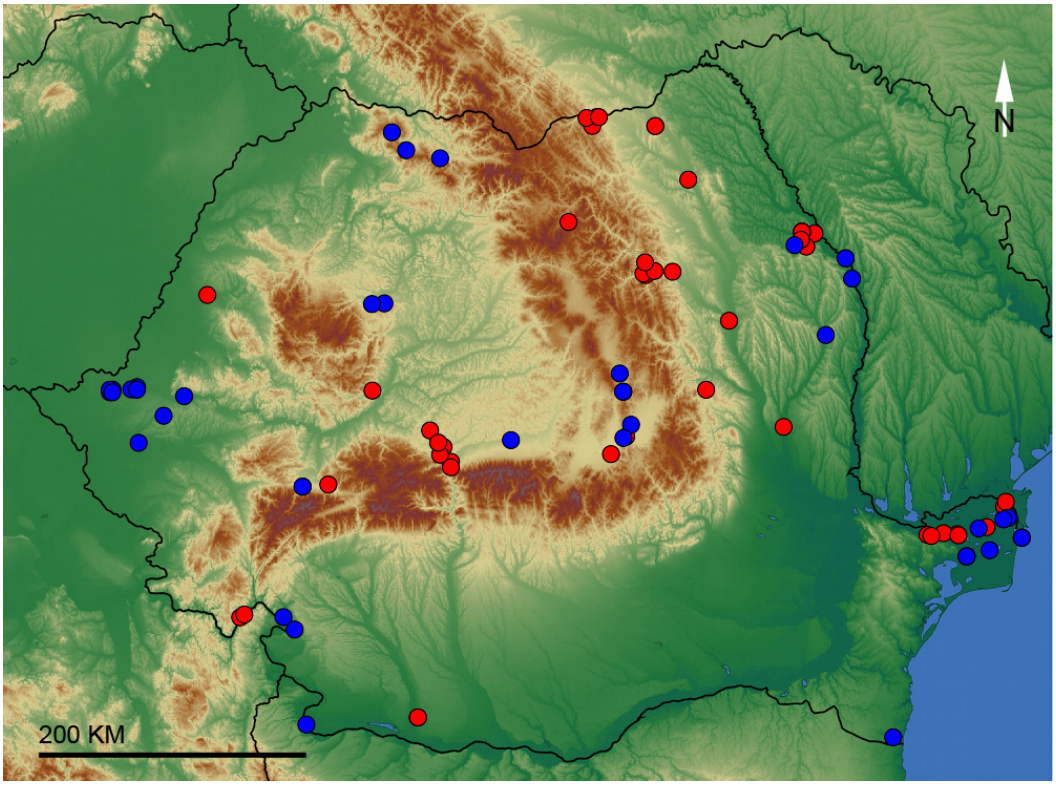

Fig. 13. Distribution map of *Lestes sponsa*

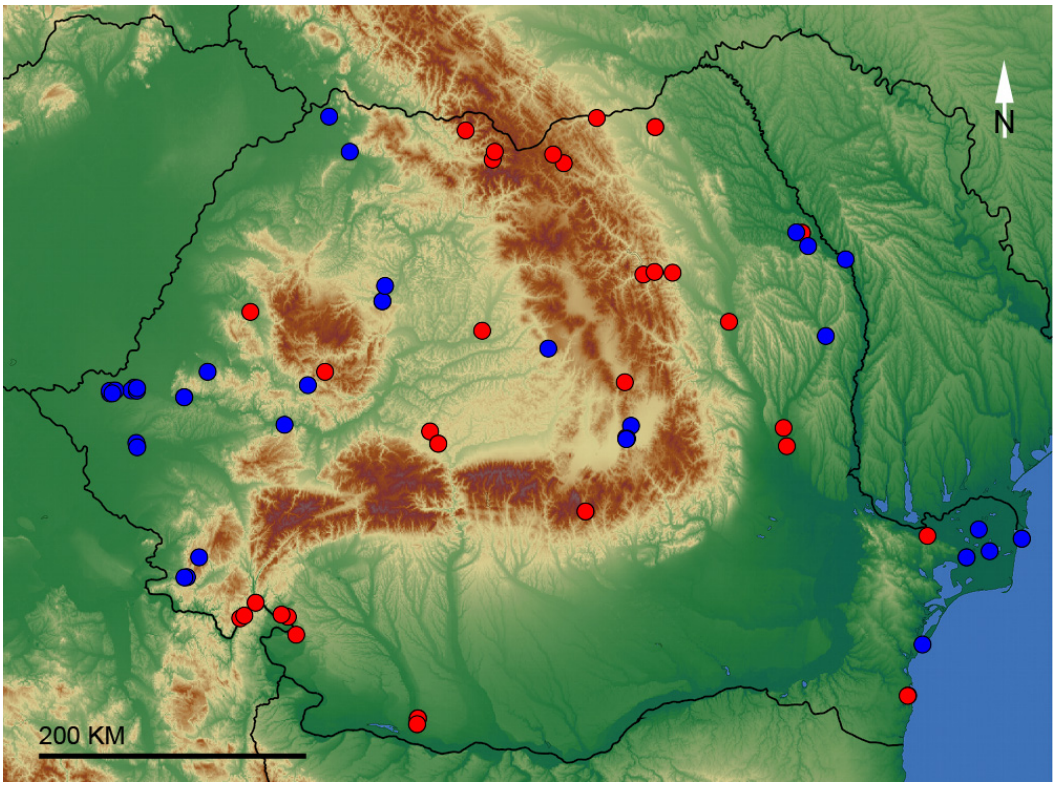

Fig. 14. Distribution map of *Lestes dryas*

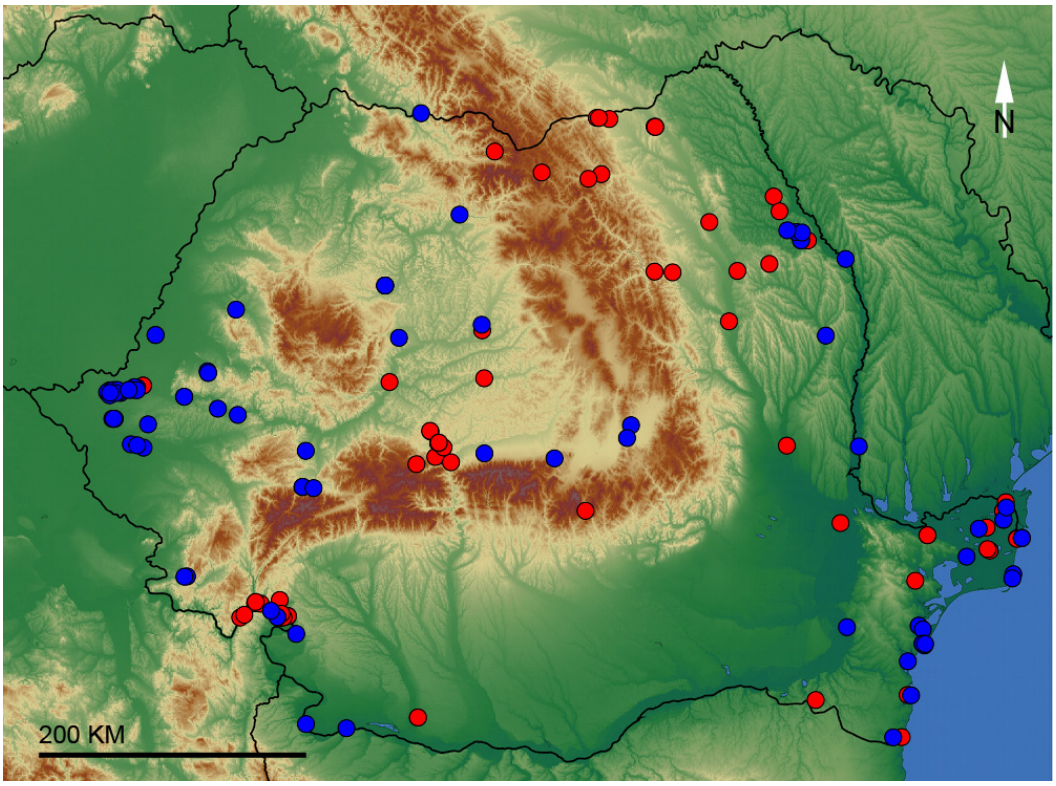

Fig. 15. Distribution map of *Lestes barbarus*

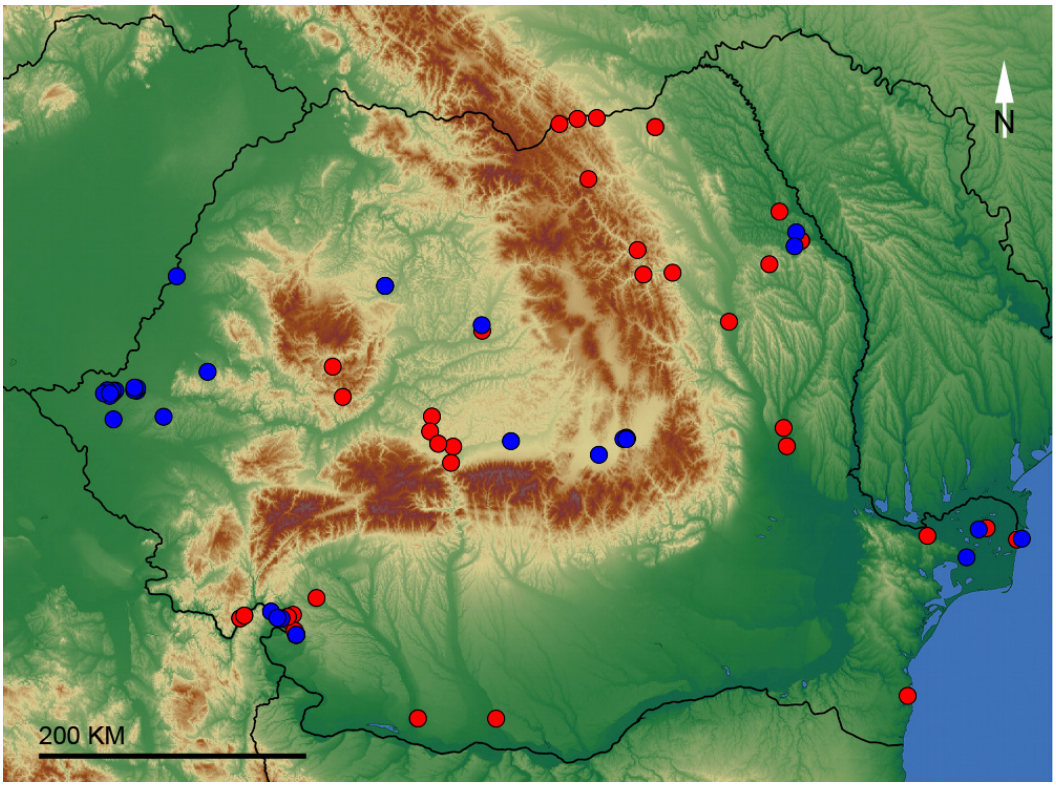

Fig. 16. Distribution map of *Lestes virens*

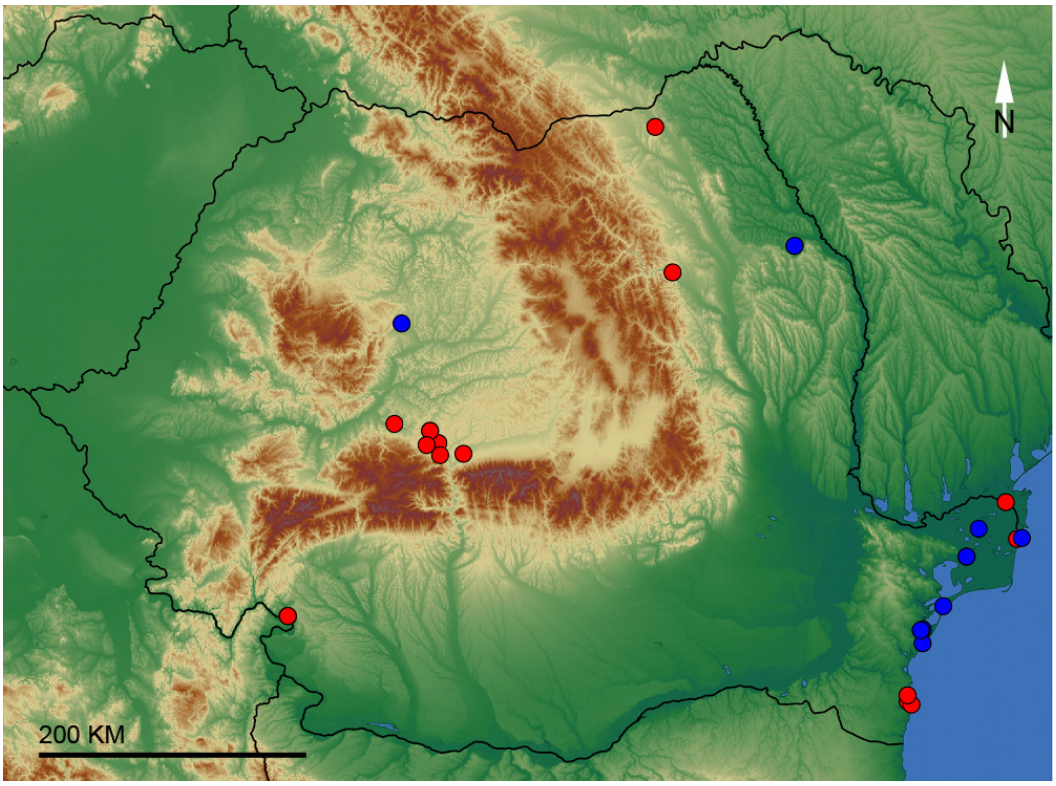

Fig. 17. Distribution map of *Lestes macrostigma*

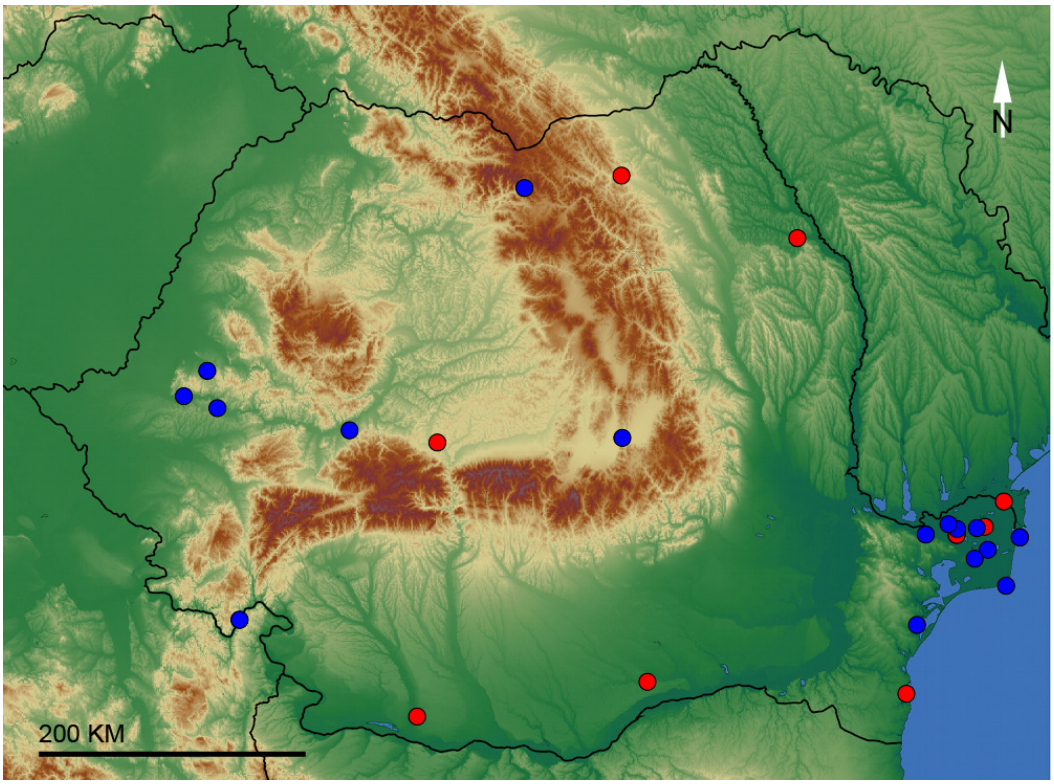

Fig. 18. Distribution map of *Lestes viridis*

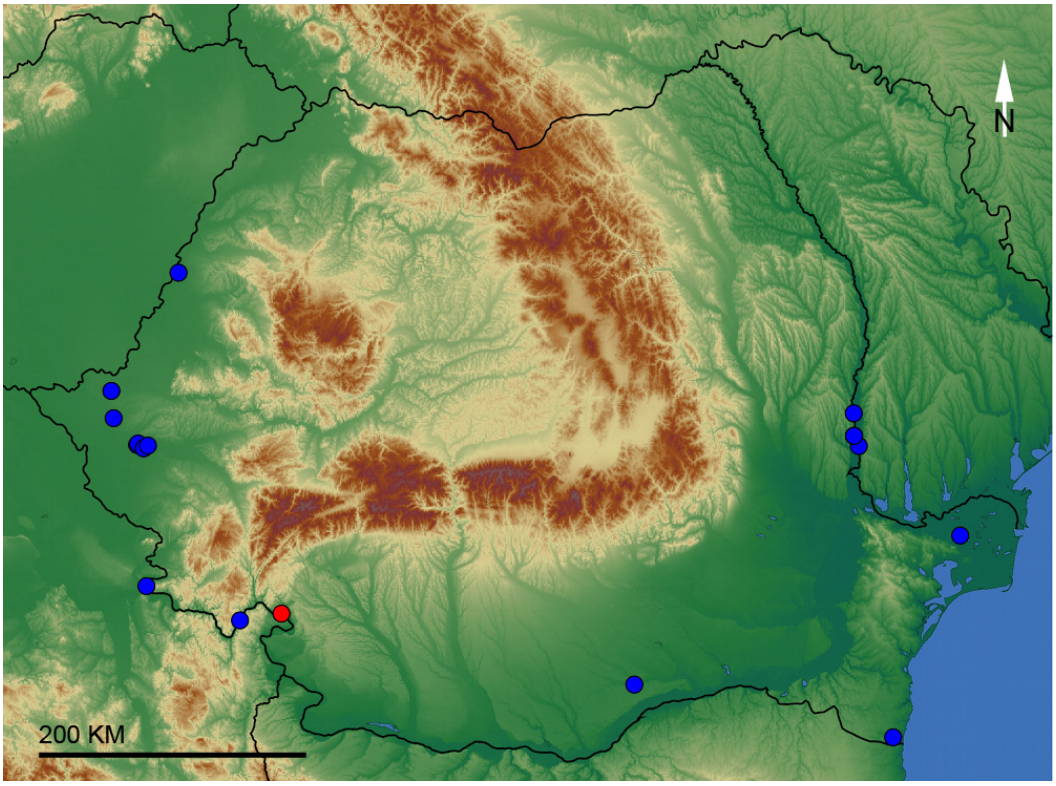

Fig. 19. Distribution map of *Lestes parvidens*

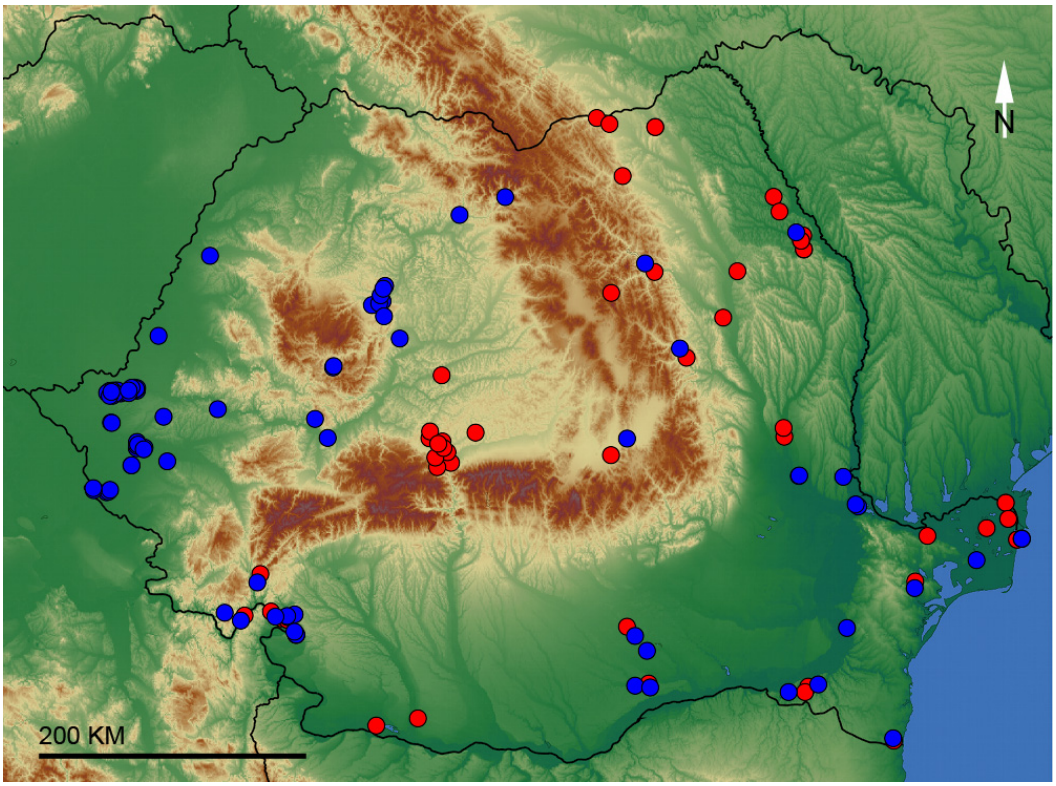

Fig. 20. Distribution map of *Sympecma fusca*

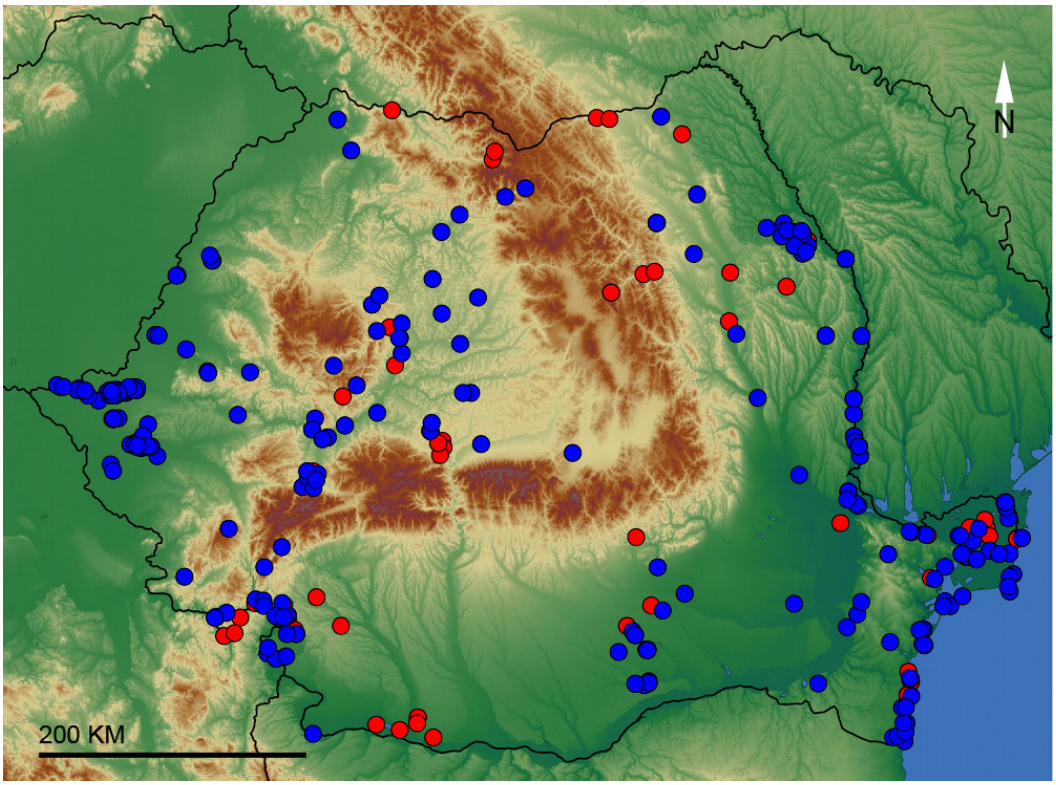

Fig. 21. Distribution map of *Ischnura elegans*

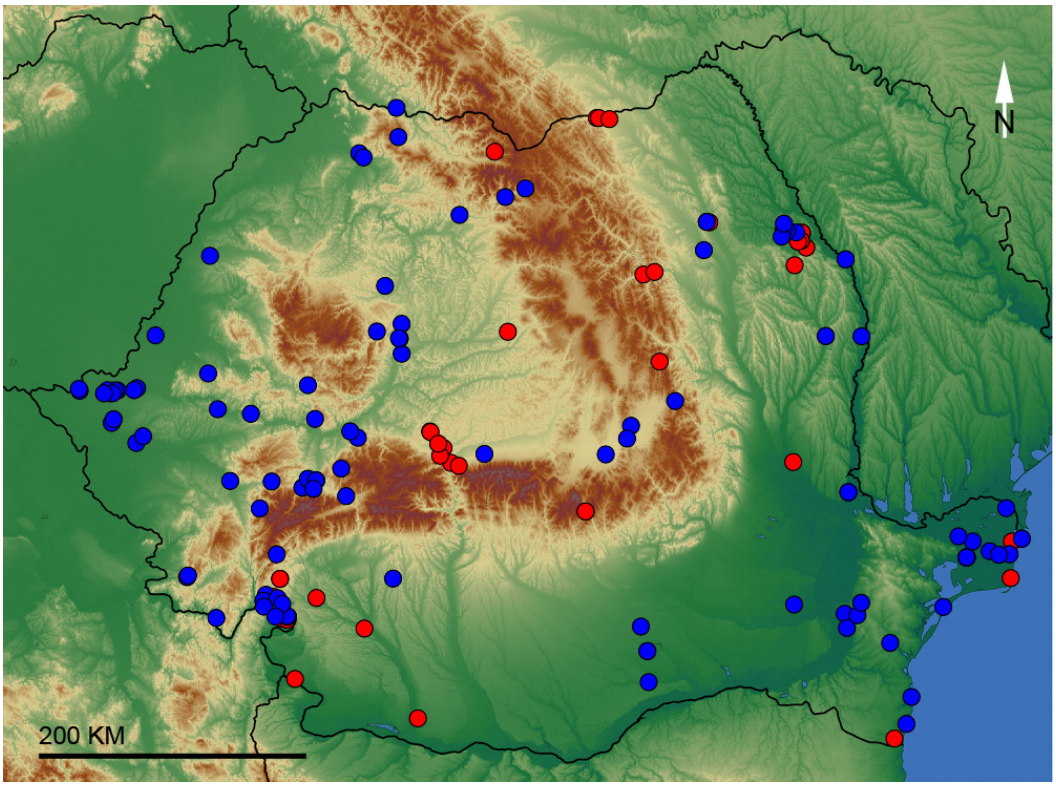

Fig. 22. Distribution map of *Ischnura pumilio*

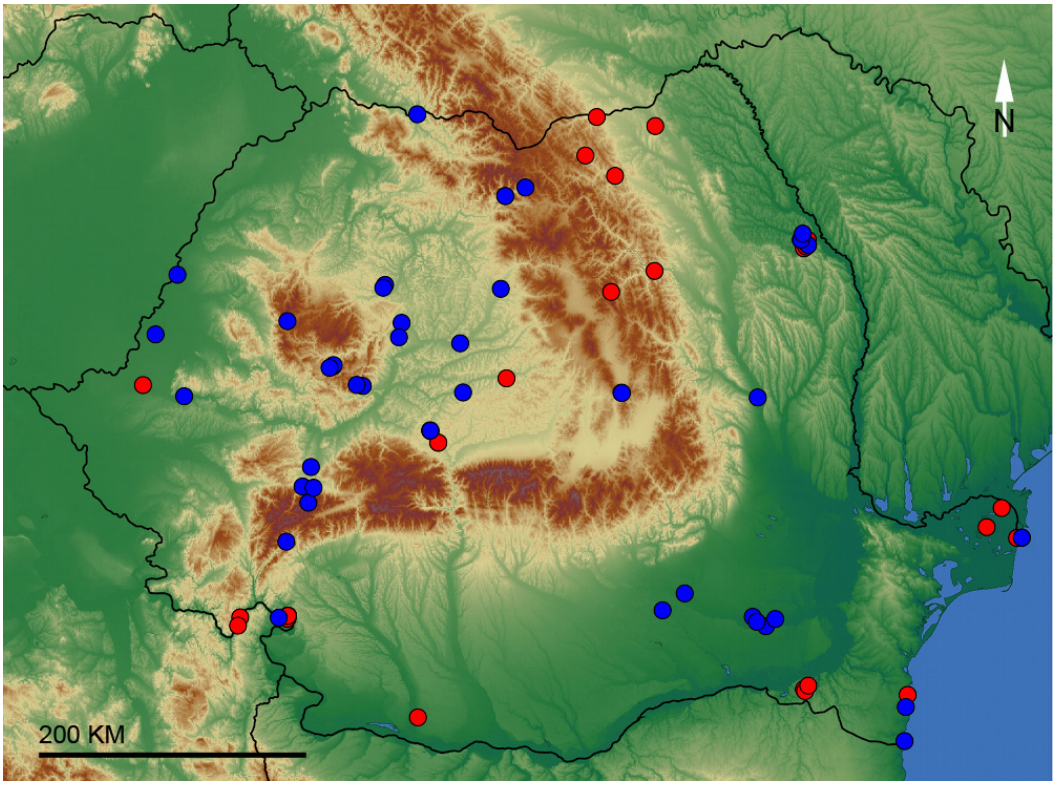

Fig. 23. Distribution map of *Enallagma cyathigerum*

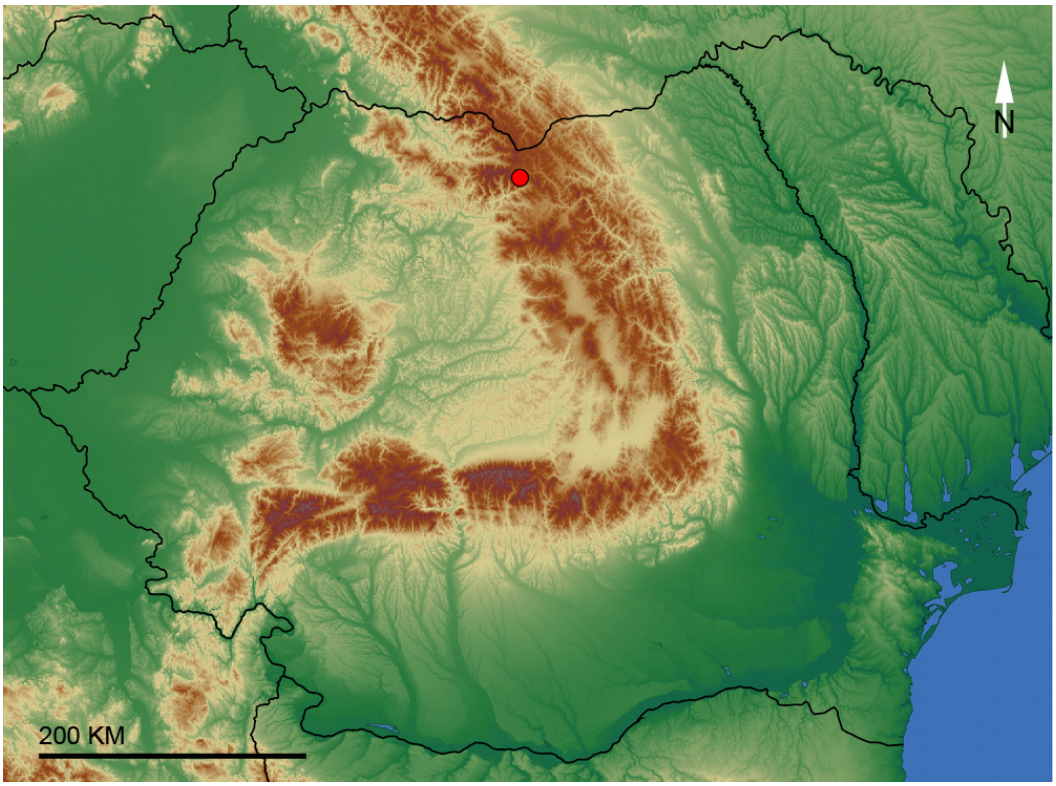

Fig. 24. Distribution map of *Coenagrion armatum*

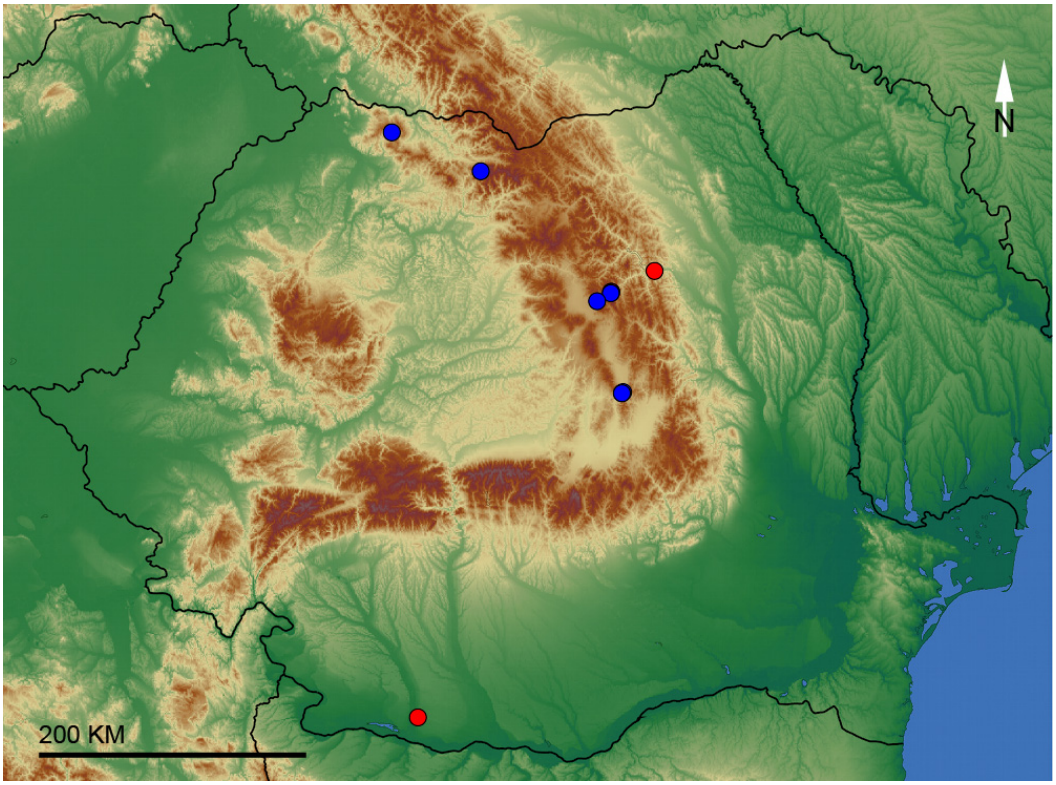

Fig. 25. Distribution map of *Coenagrion hastulatum*

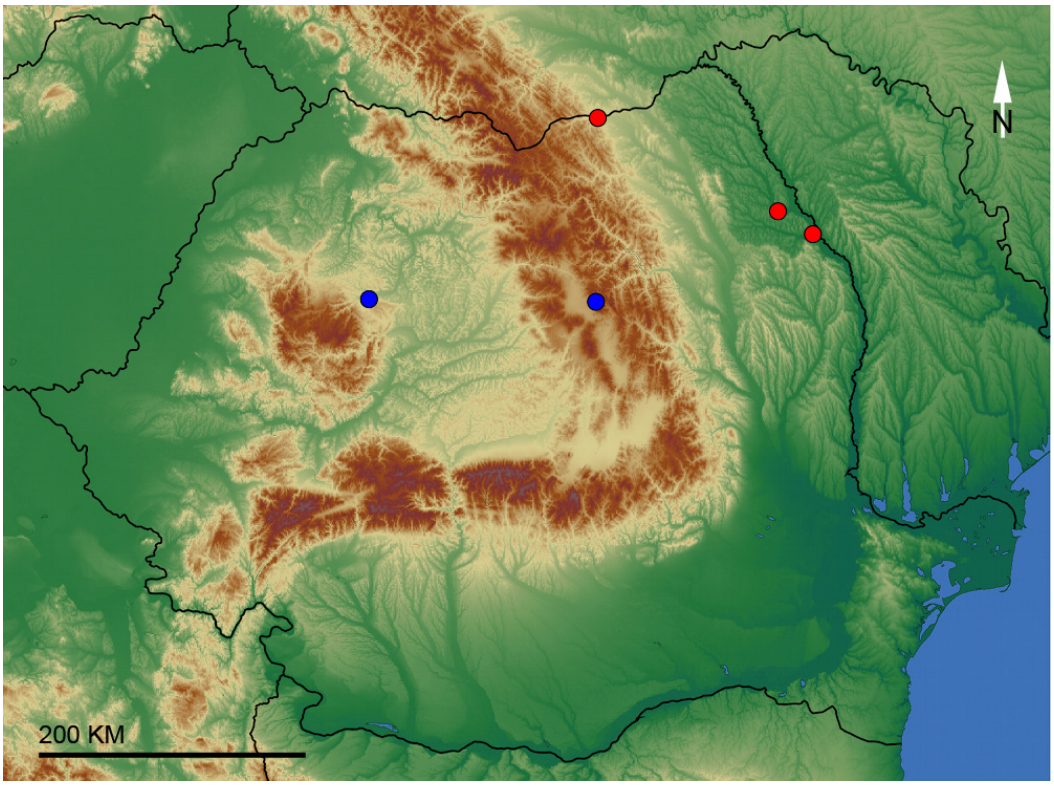

Fig. 26. Distribution map of *Coenagrion lunulatum*

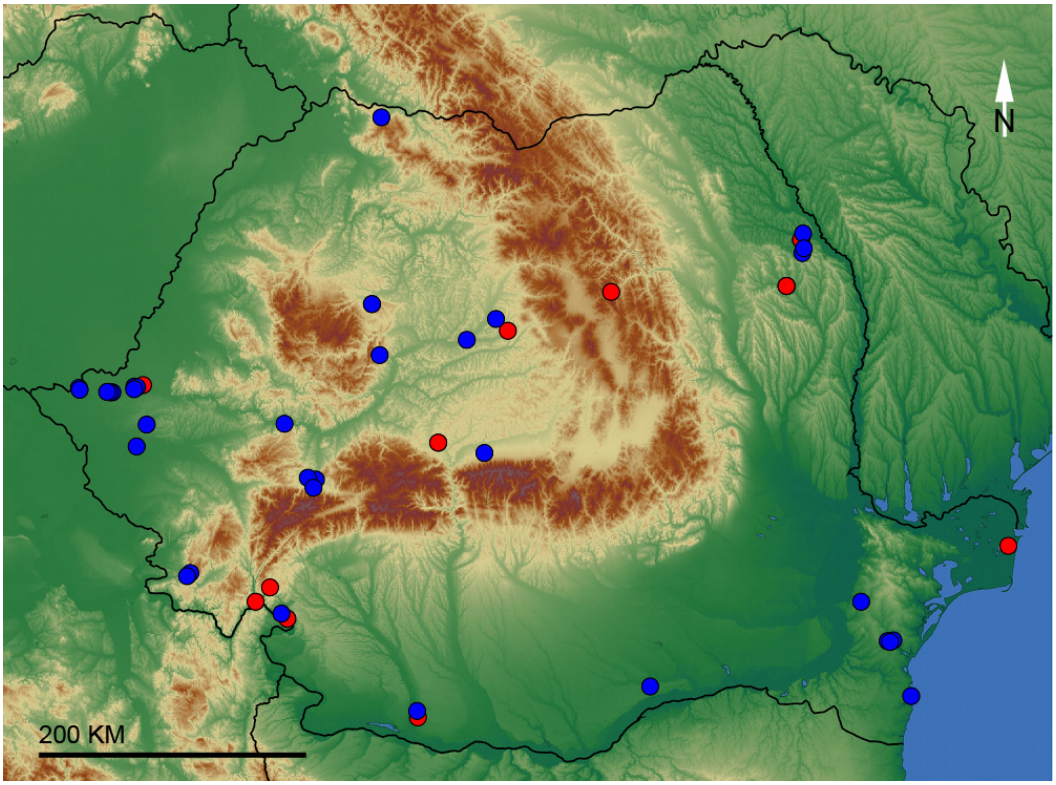

Fig. 27. Distribution map of *Coenagrion ornatum*

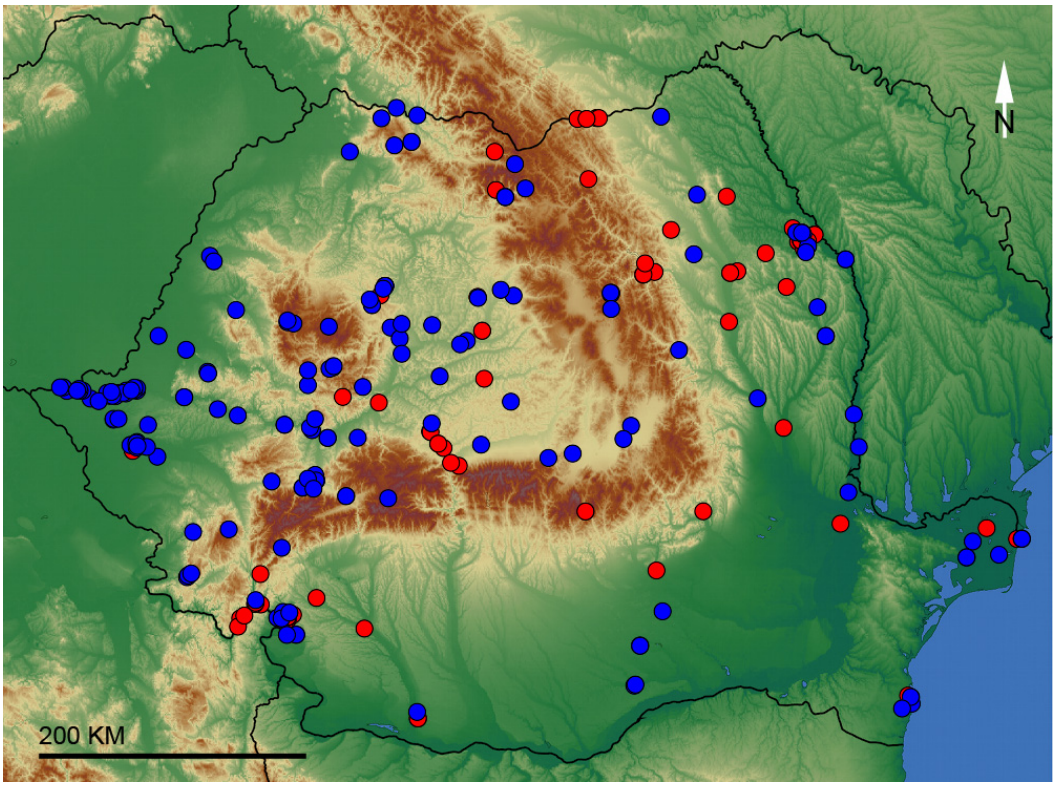

Fig. 28. Distribution map of *Coenagrion puella*

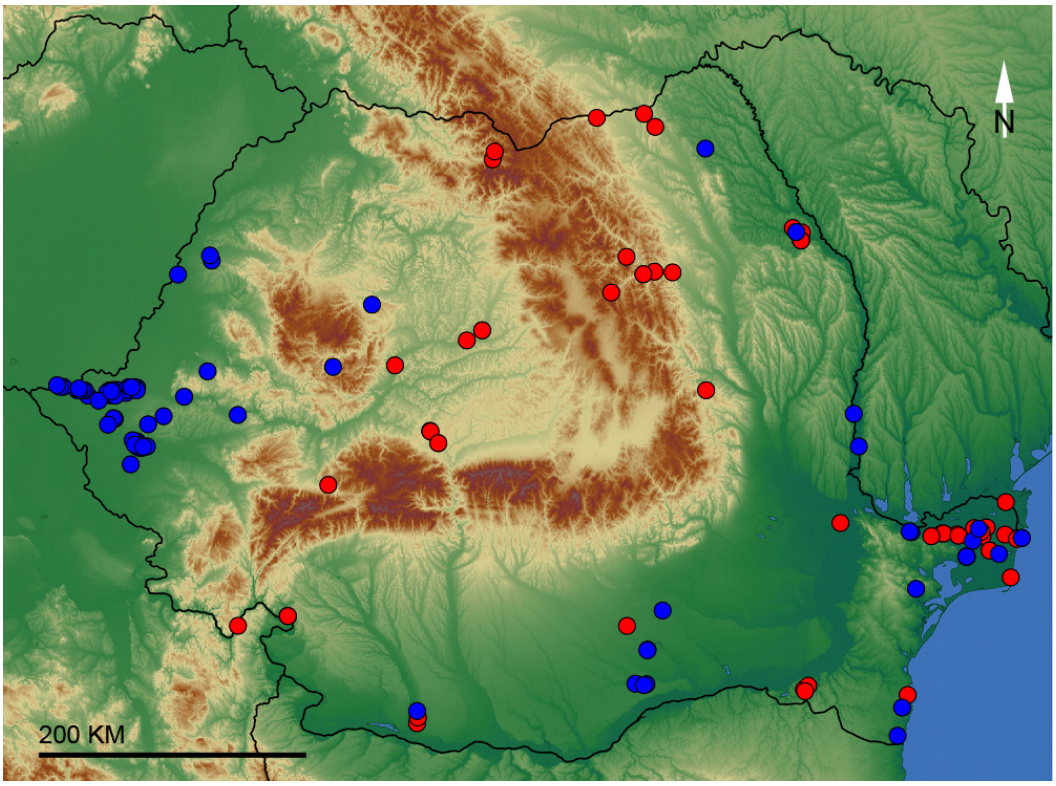

Fig. 29. Distribution map of *Coenagrion pulchellum*

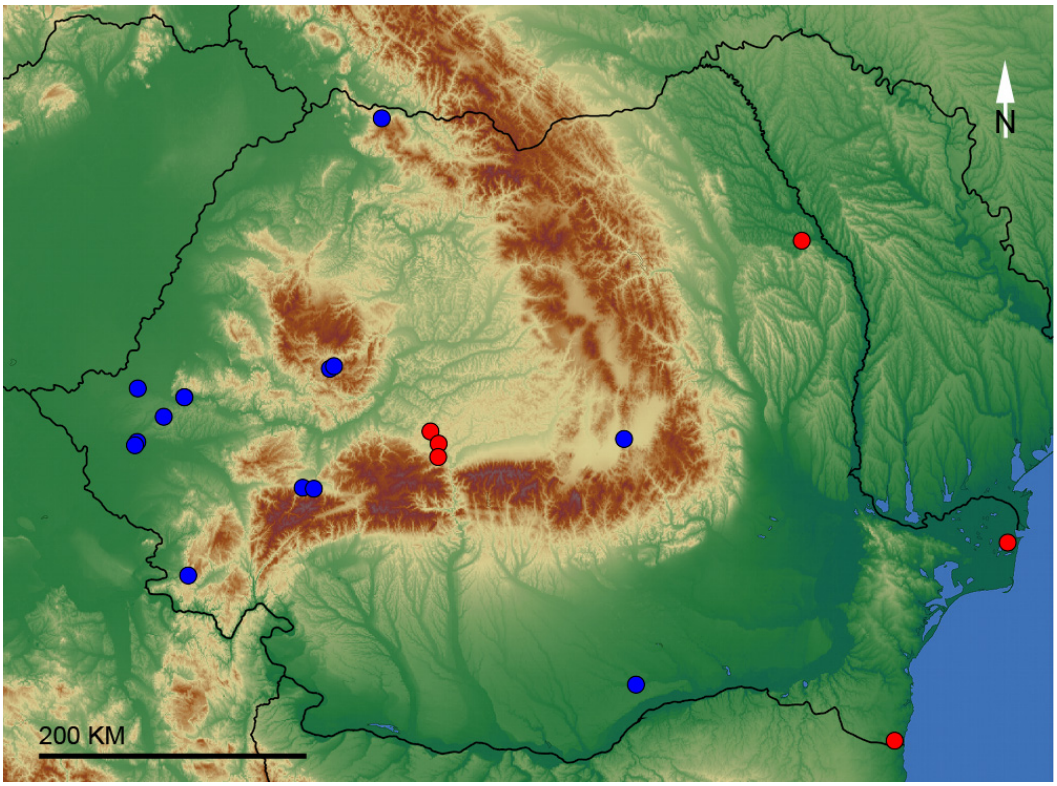

Fig. 30. Distribution map of *Coenagrion scitulum*

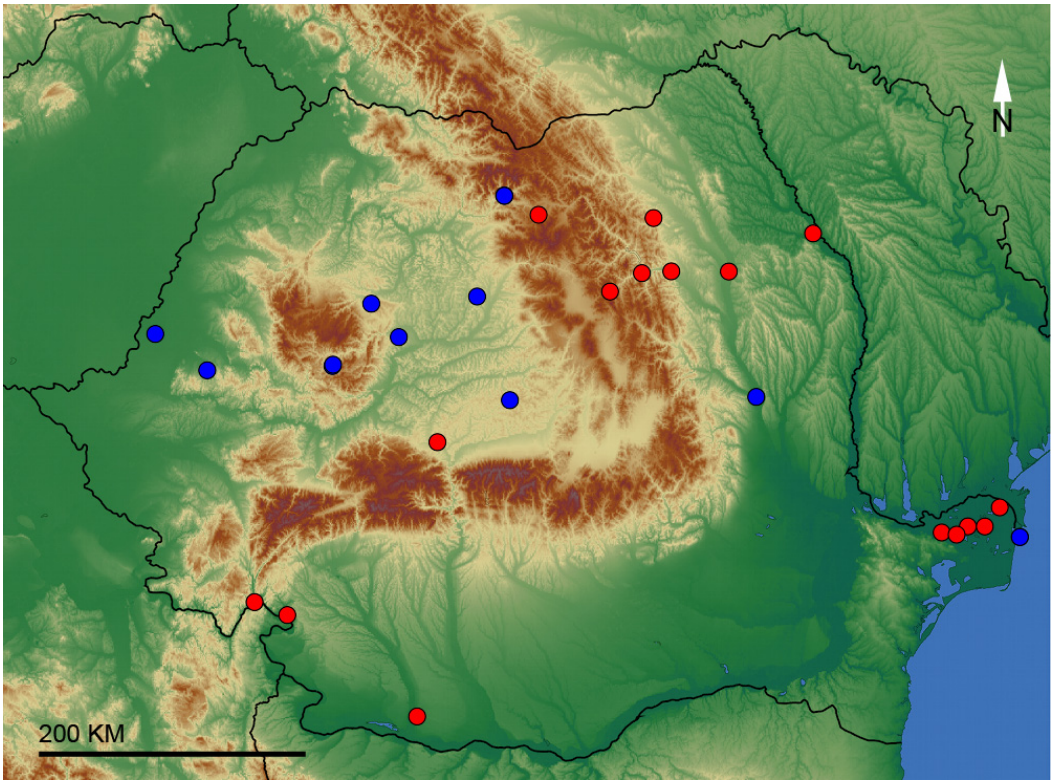

Fig. 31. Distribution map of *Erythromma najas*

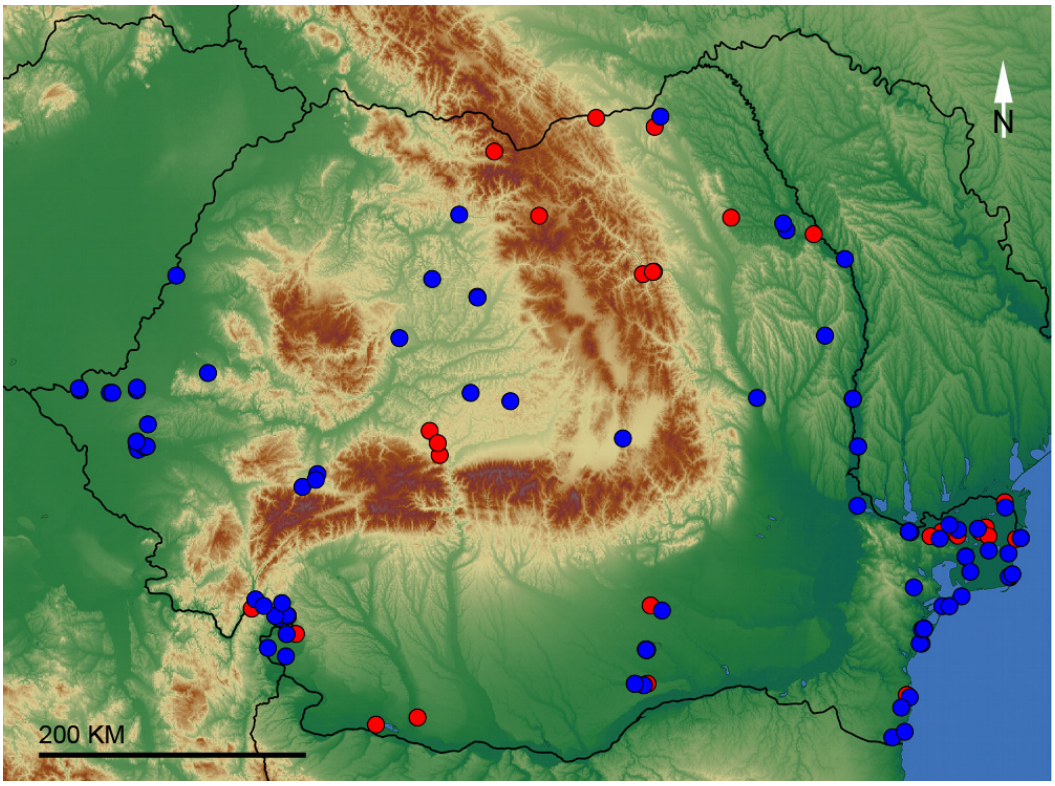

Fig. 32. Distribution map of *Erythromma viridulum*

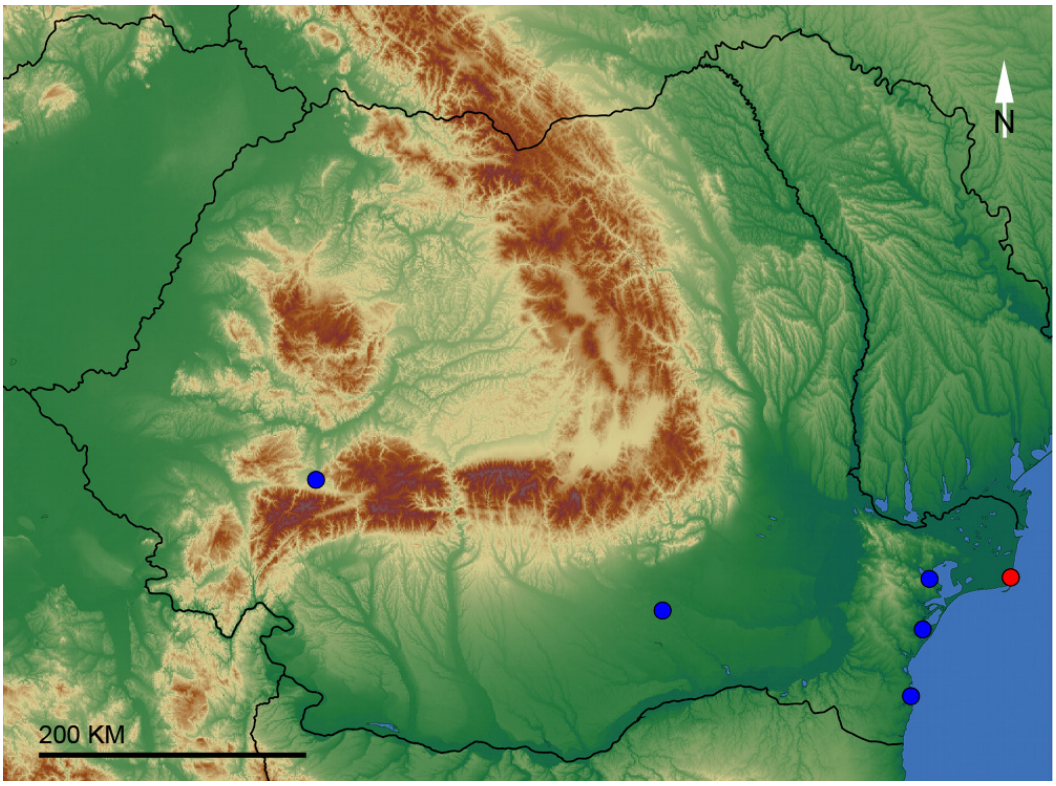

Fig. 33. Distribution map of *Erythromma lindenii*

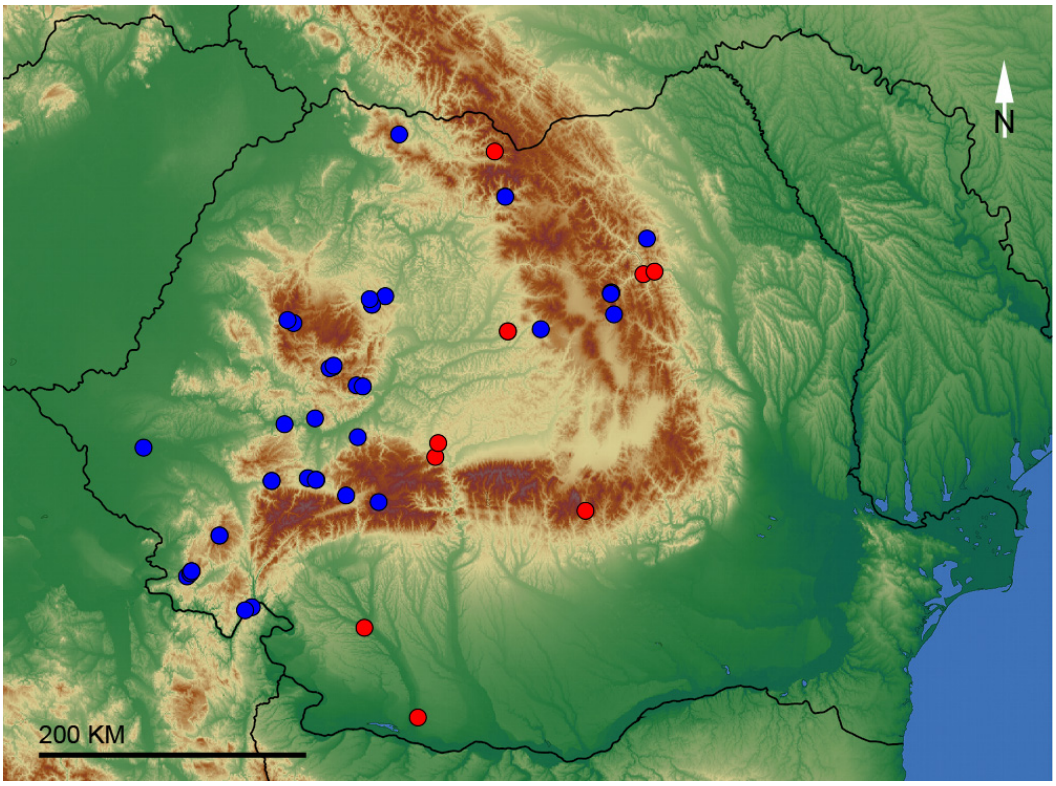

Fig. 34. Distribution map of *Pyrrhosoma nymphula*

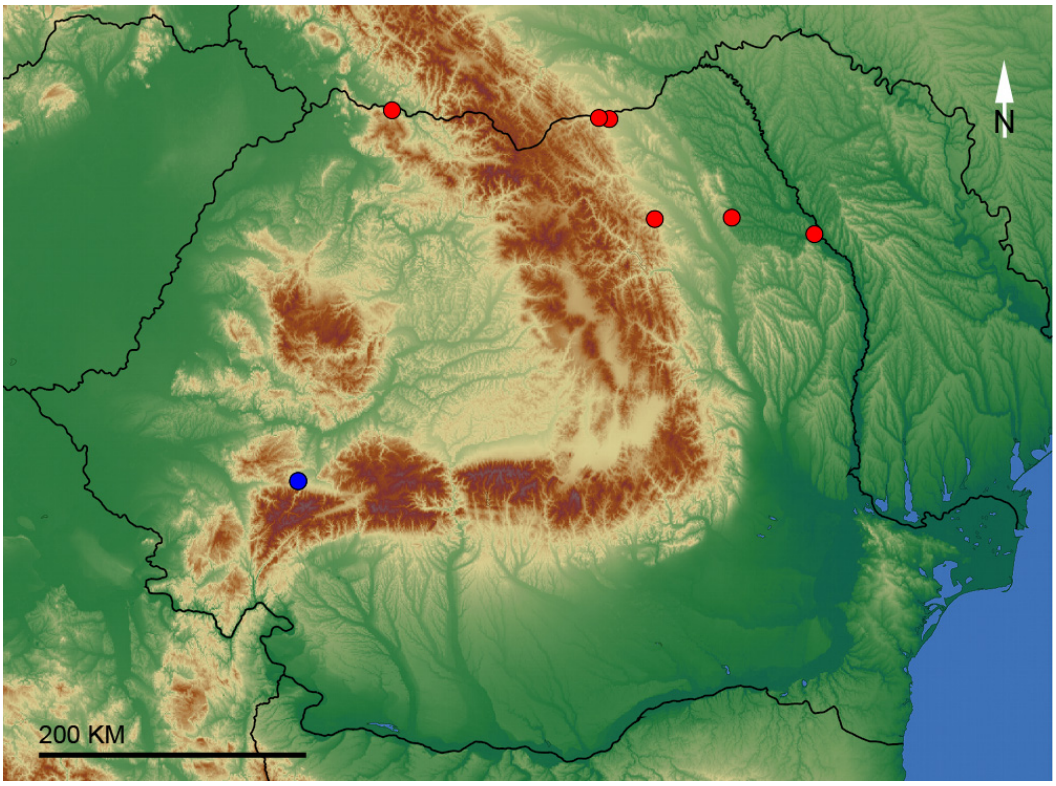

Fig. 35. Distribution map of *Nehalennia speciosa*

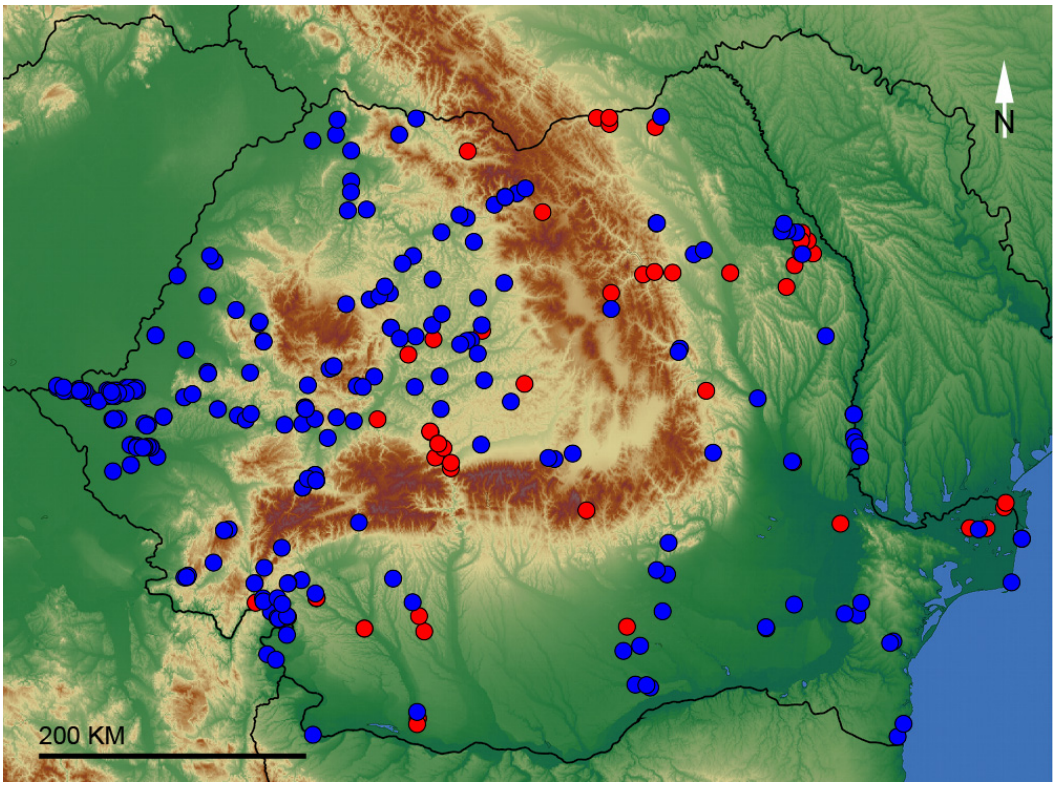

Fig. 36. Distribution map of *Platycnemis pennipes*

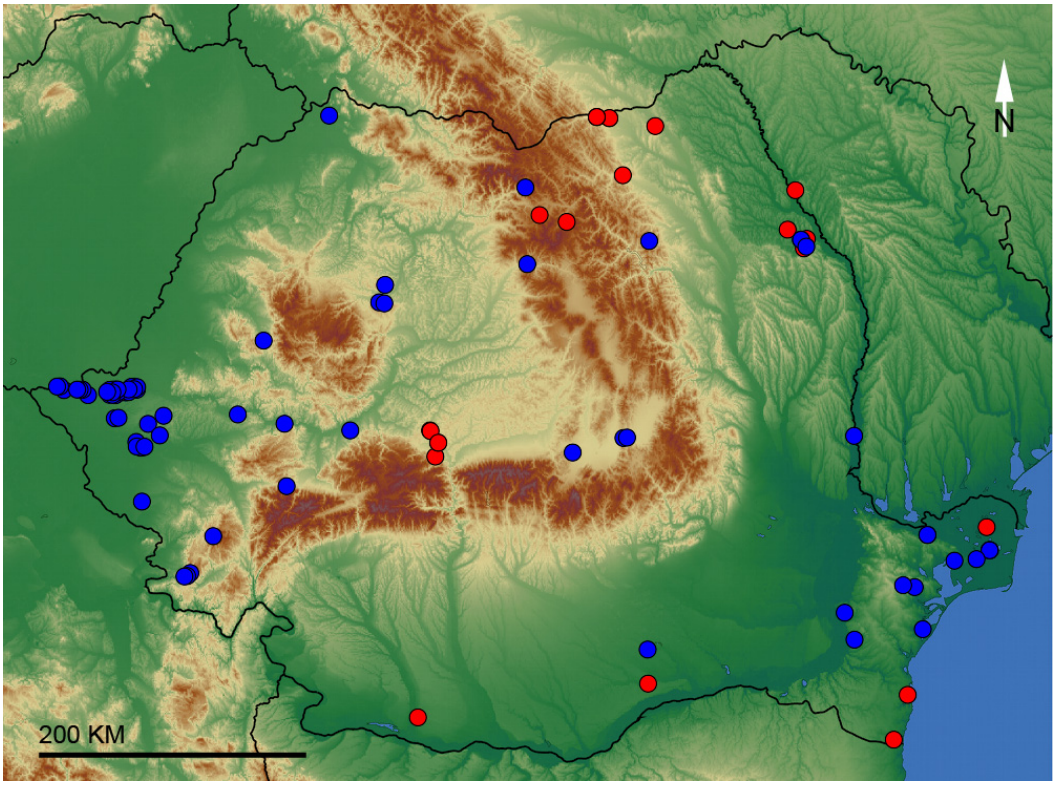

Fig. 36. Distribution map of *Aeshna affinis*

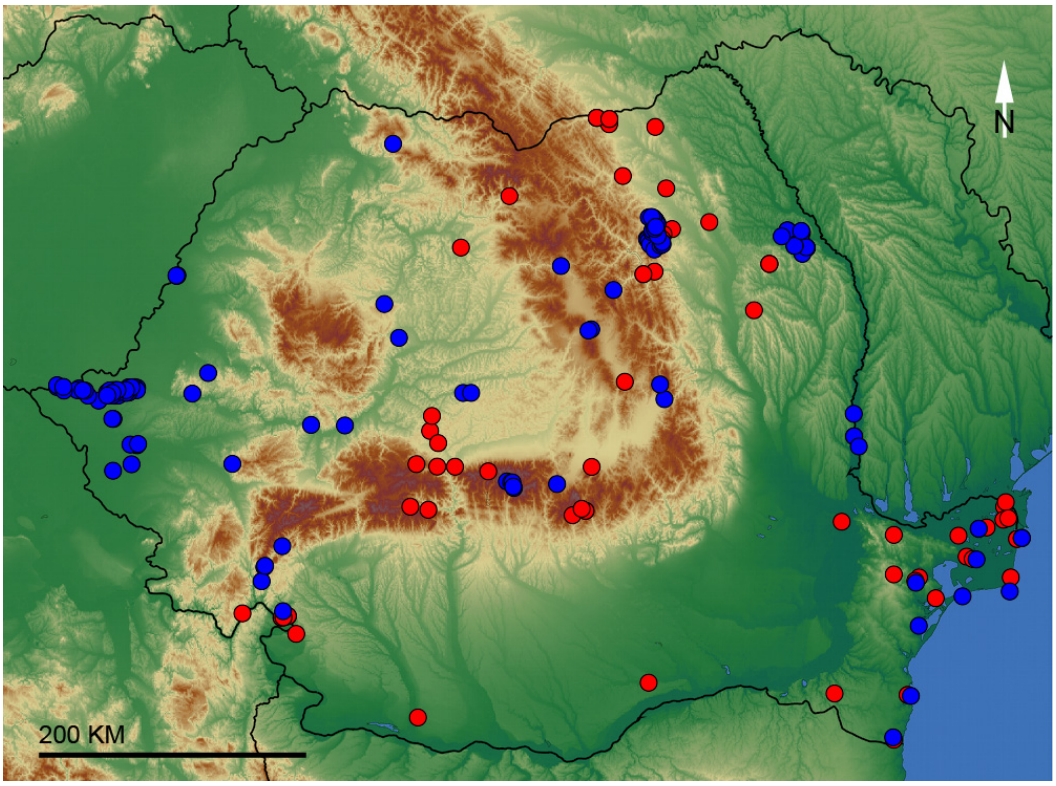

Fig. 38. Distribution map of *Aeshna mixta*

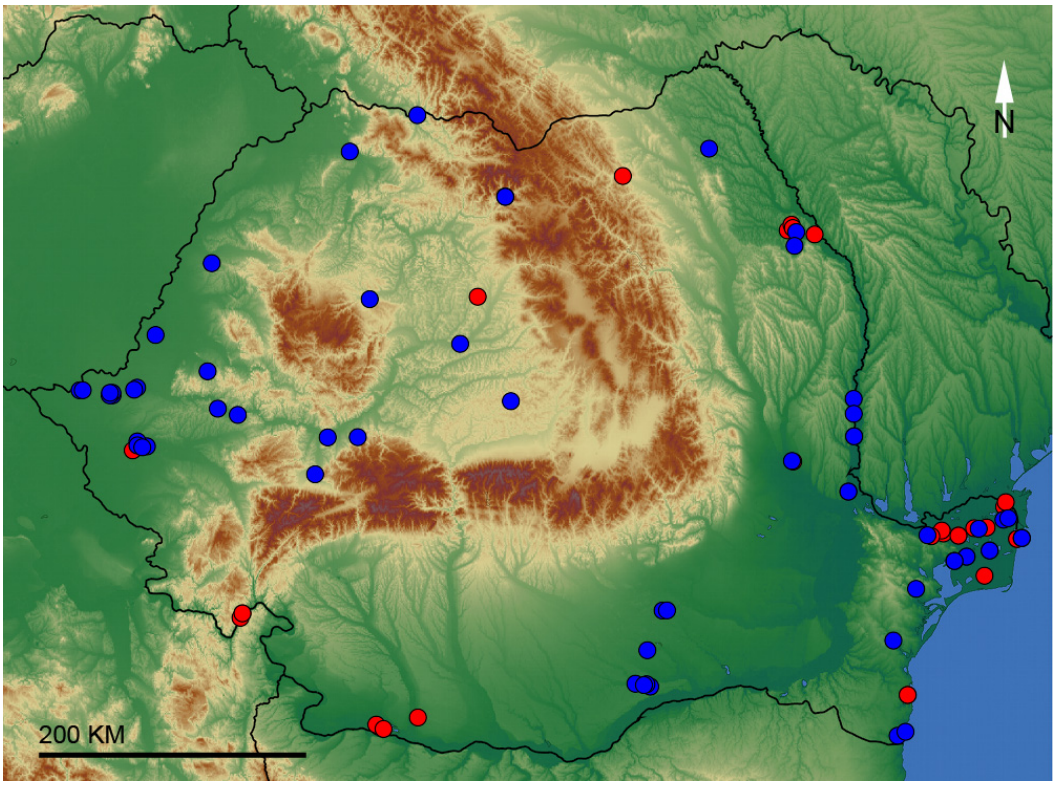

Fig. 39. Distribution map of *Aeshna isoceles*

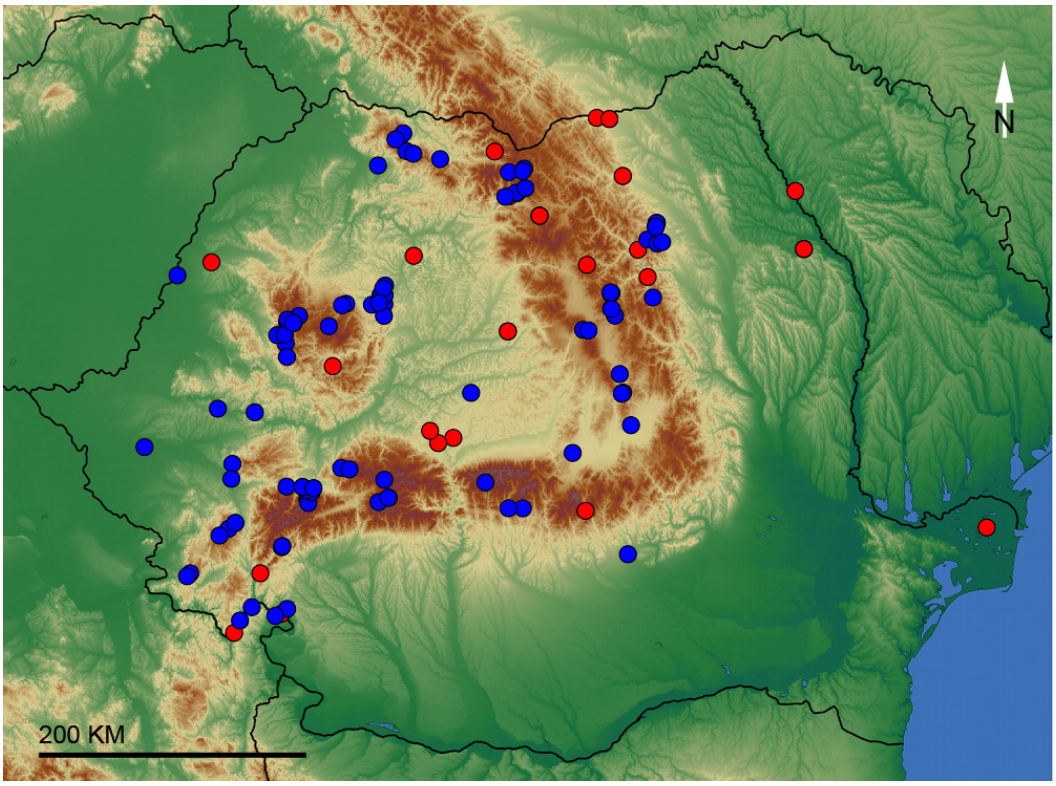

Fig. 40. Distribution map of *Aeshna cyanea*

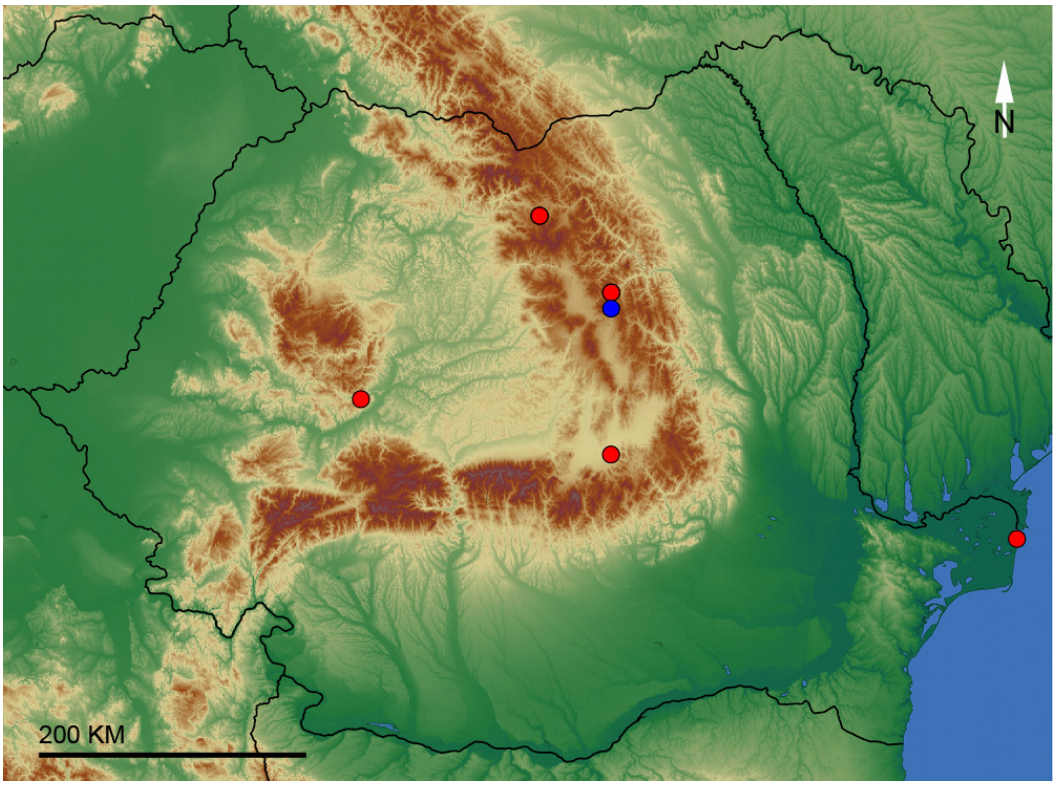

Fig. 41. Distribution map of *Aeshna grandis*

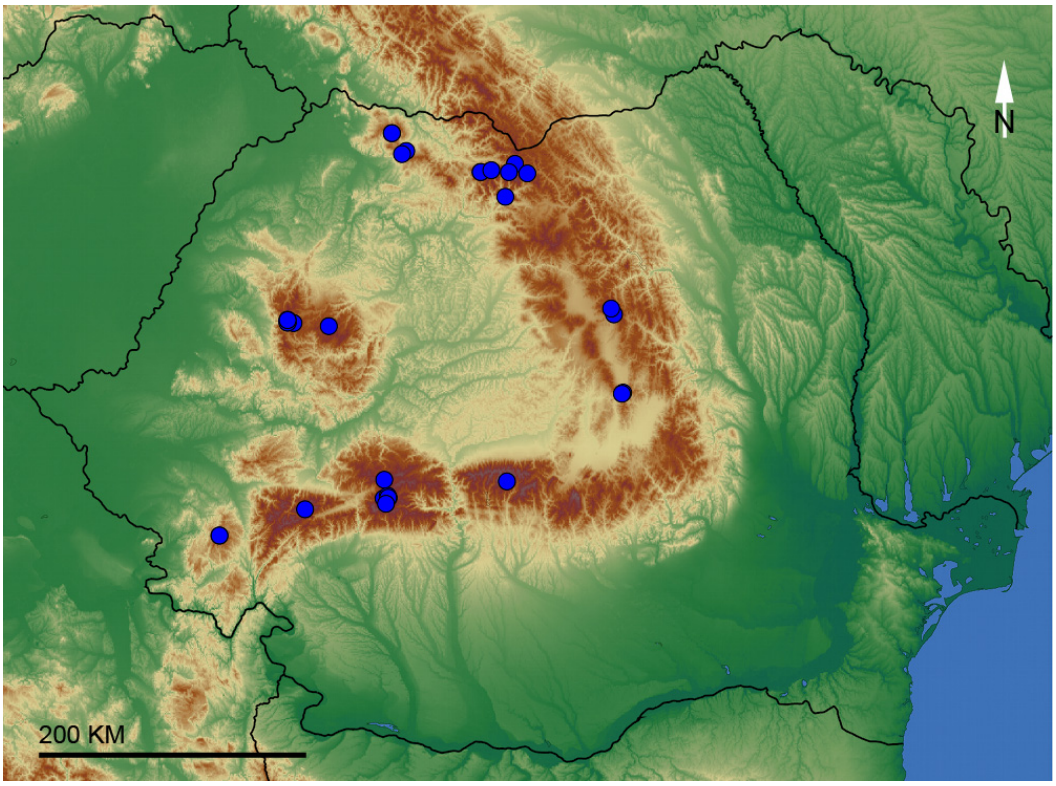

Fig. 42. Distribution map of *Aeshna juncea*

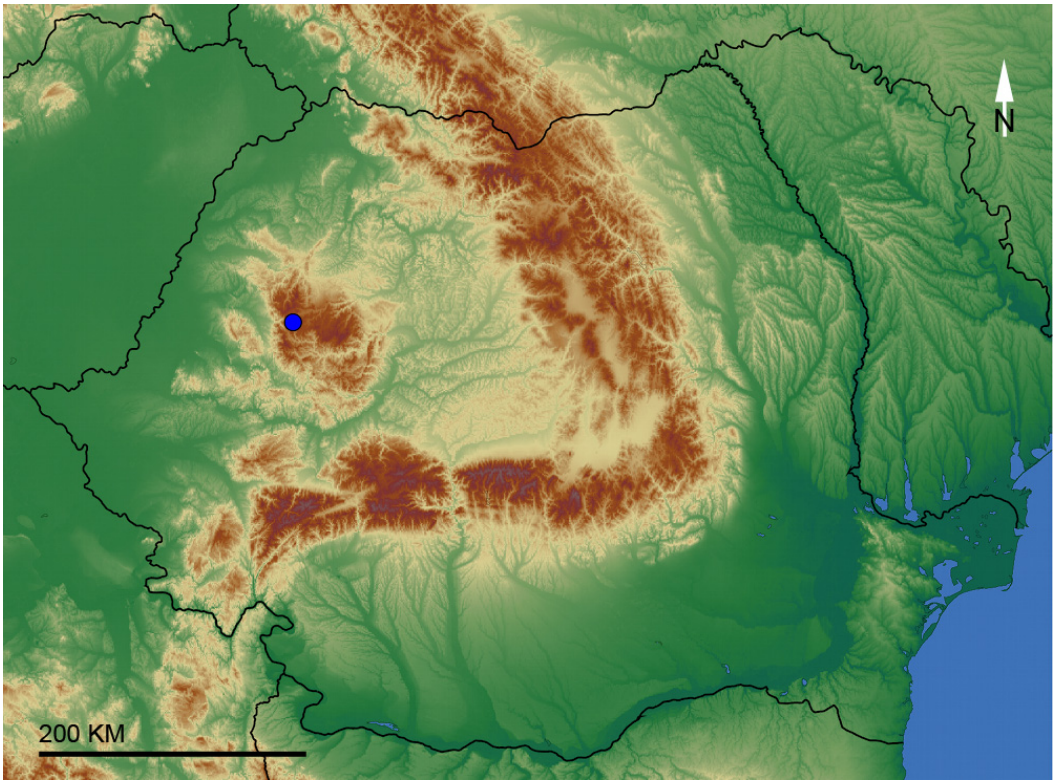

Fig. 43. Distribution map of *Aeshna subarctica*

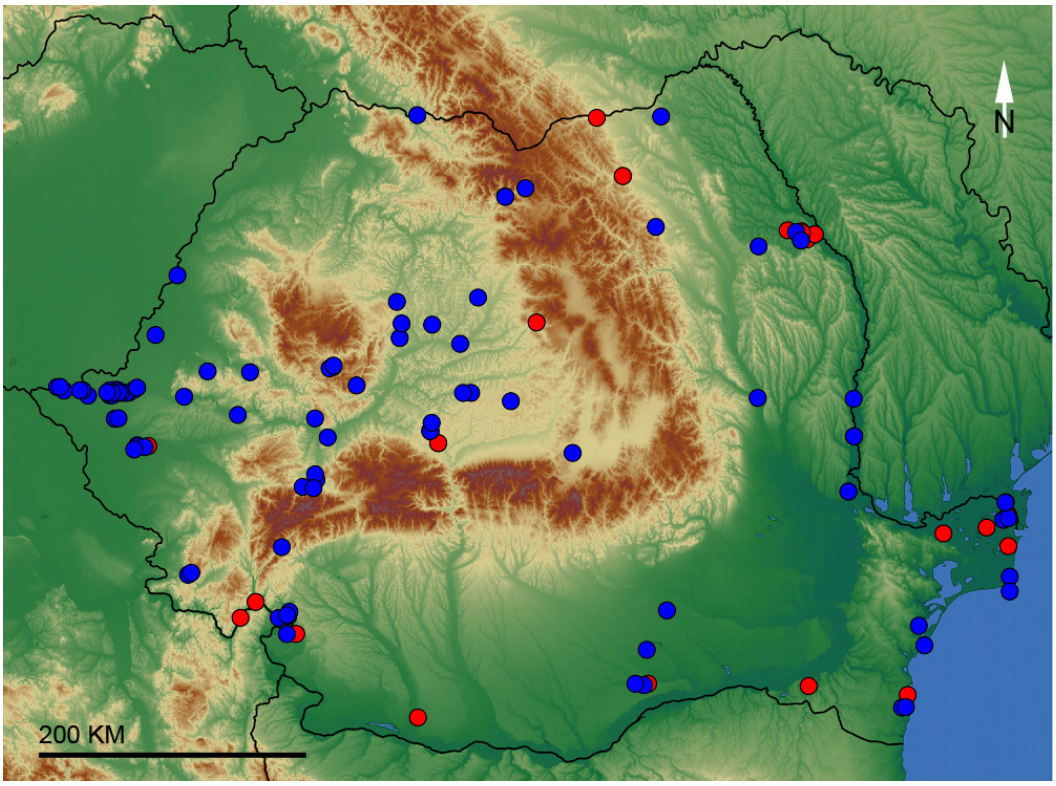

Fig. 44. Distribution map of *Anax imperator*

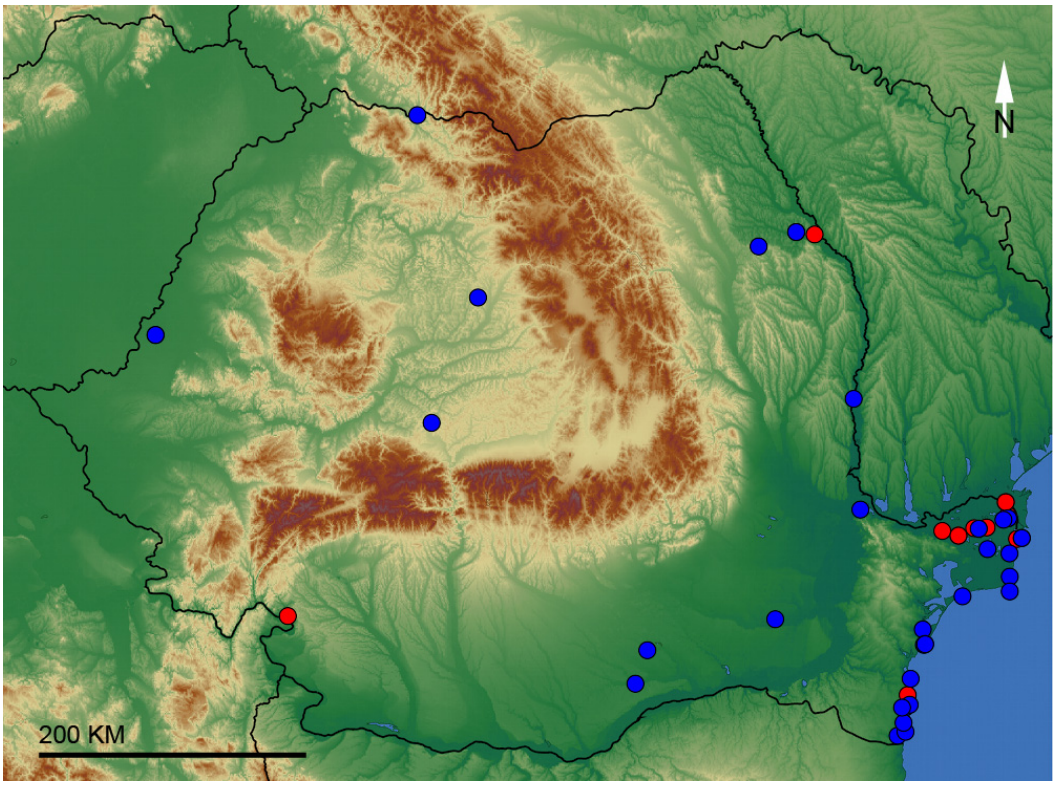

Fig. 45. Distribution map of *Anax parthenope*

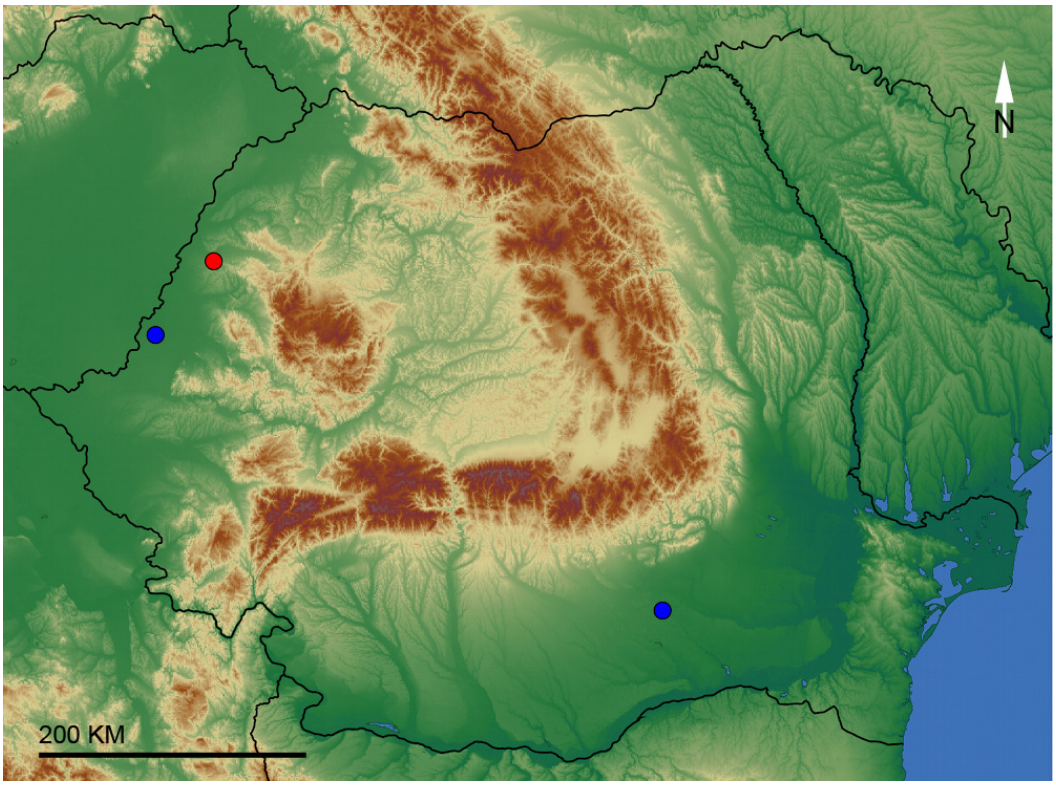

Fig. 46. Distribution map of *Anax ephippiger*

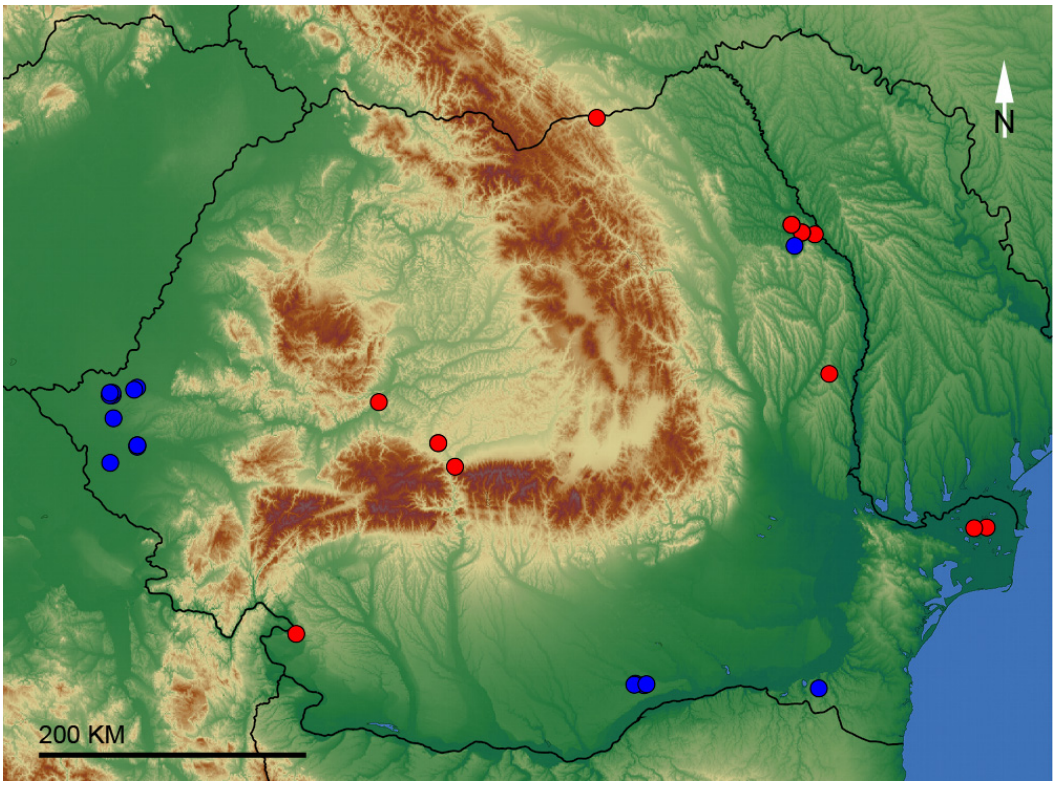

Fig. 47. Distribution map of *Brachytron pratense*

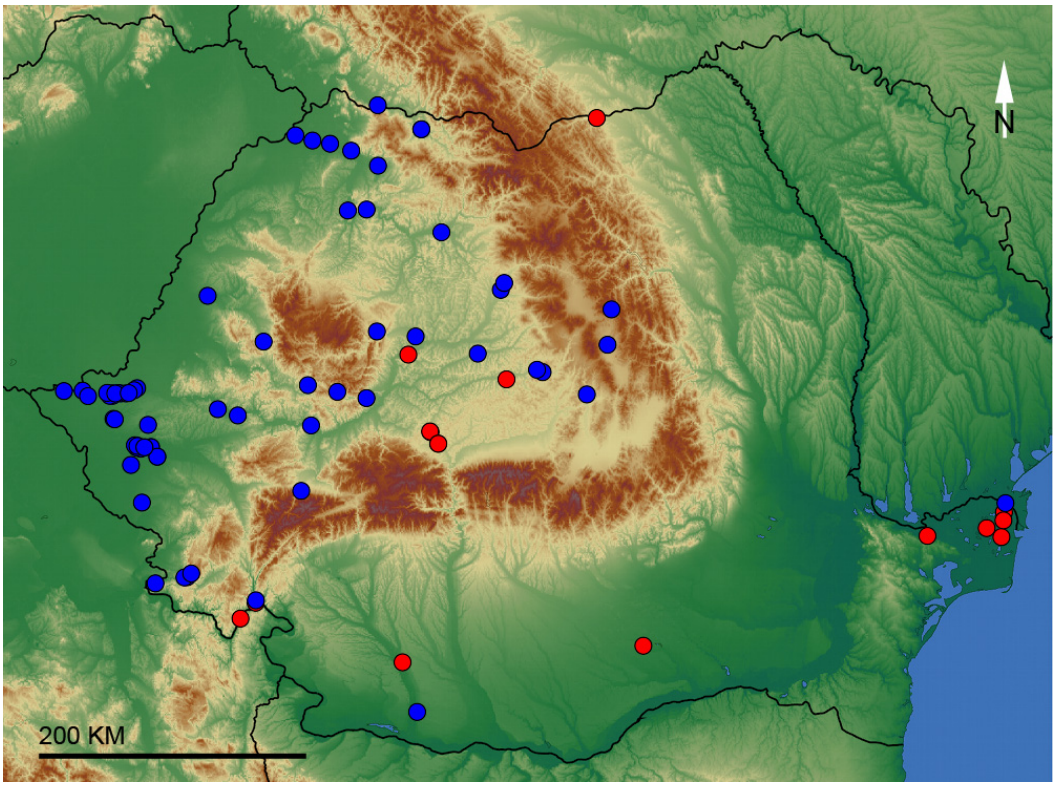

Fig. 48. Distribution map of *Gomphus vulgatissimus*

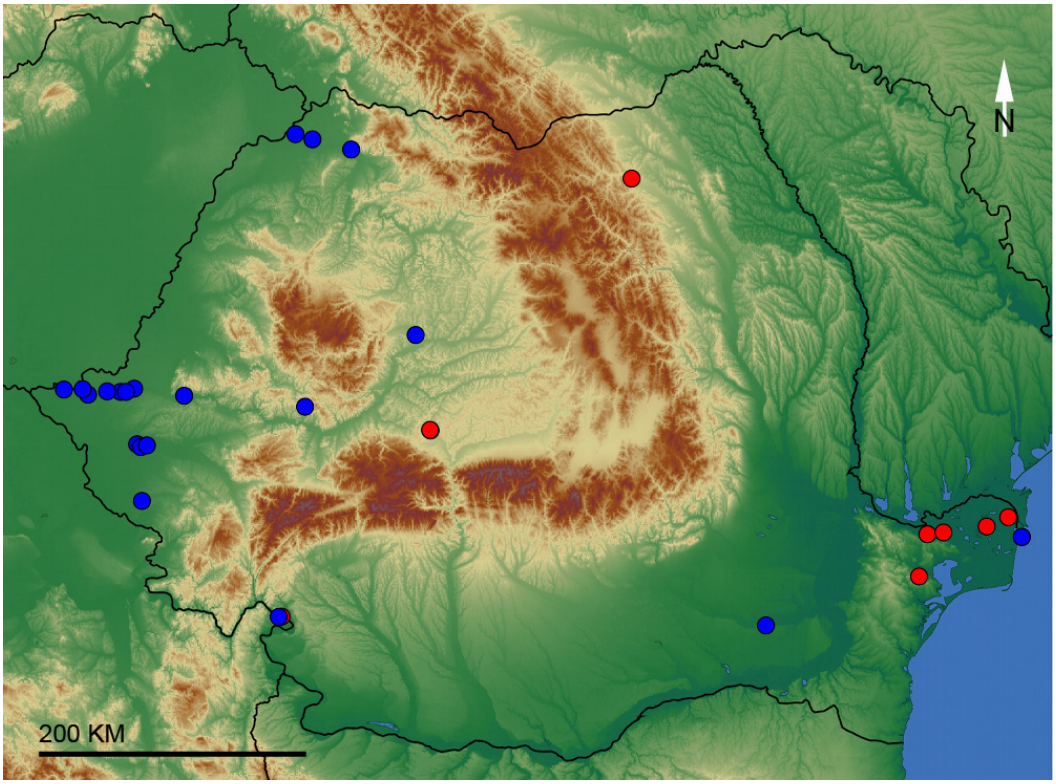

Fig. 49. Distribution map of *Gomphus flavipes*

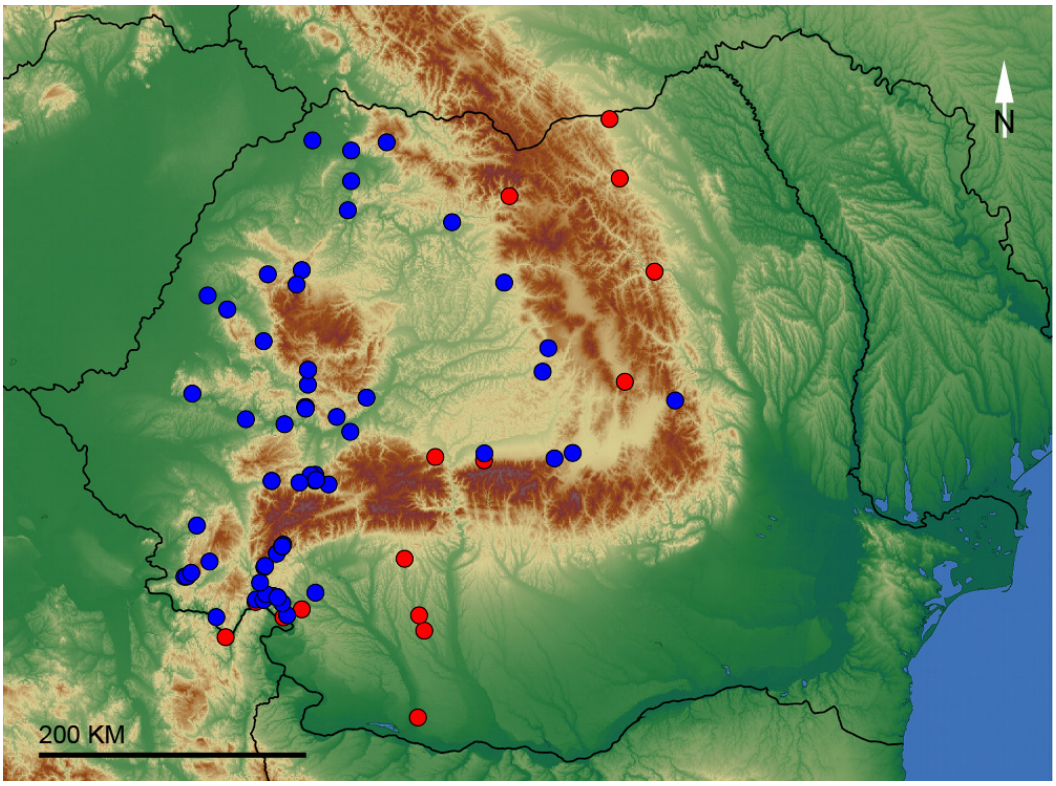

Fig. 50. Distribution map of *Onychogomphus forcipatus*

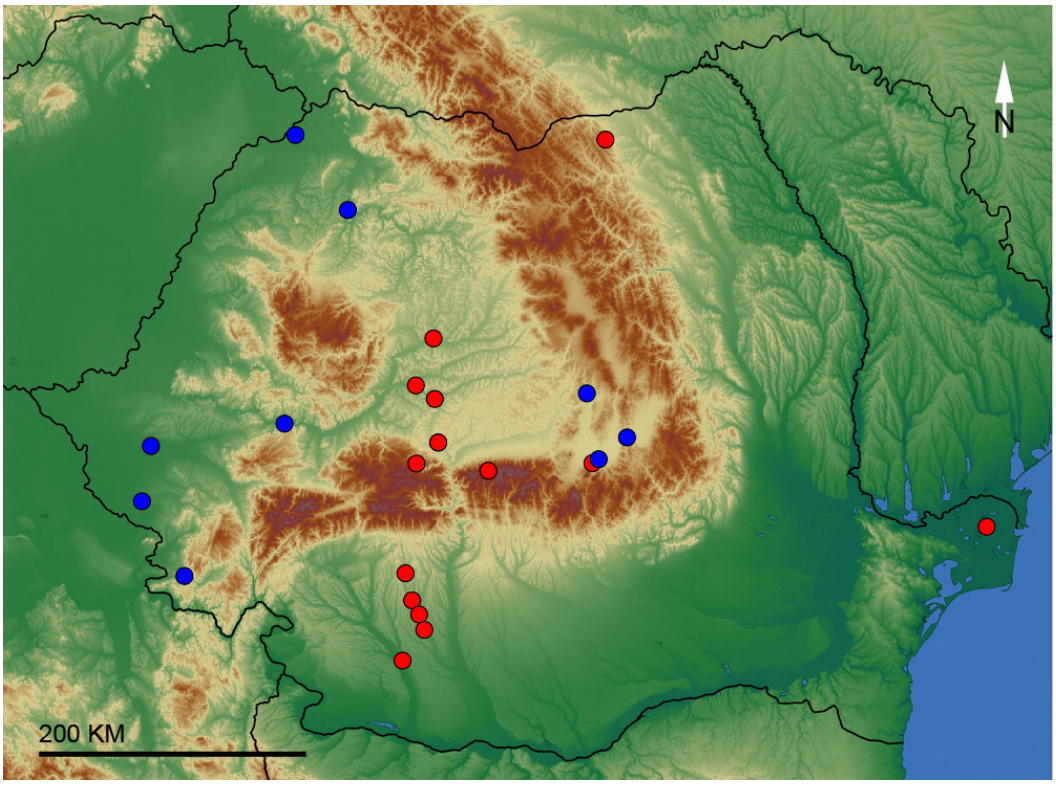

Fig. 51. Distribution map of *Ophiogomphus cecilia*

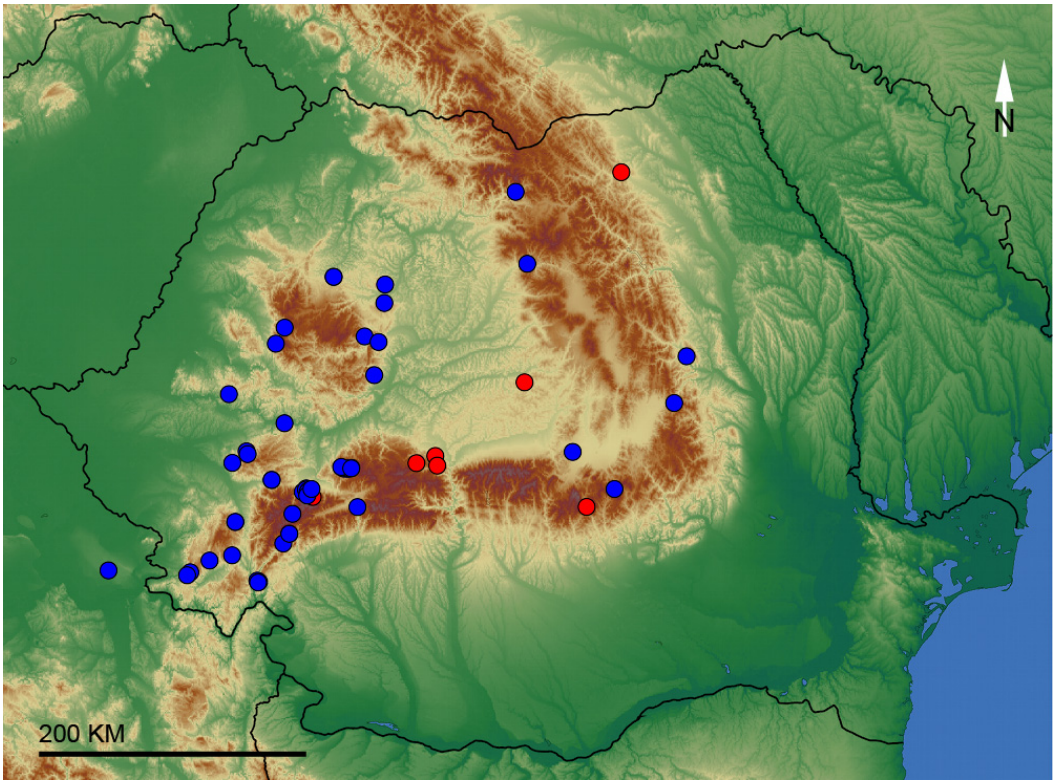

Fig. 52. Distribution map of *Cordulegaster bidentata*

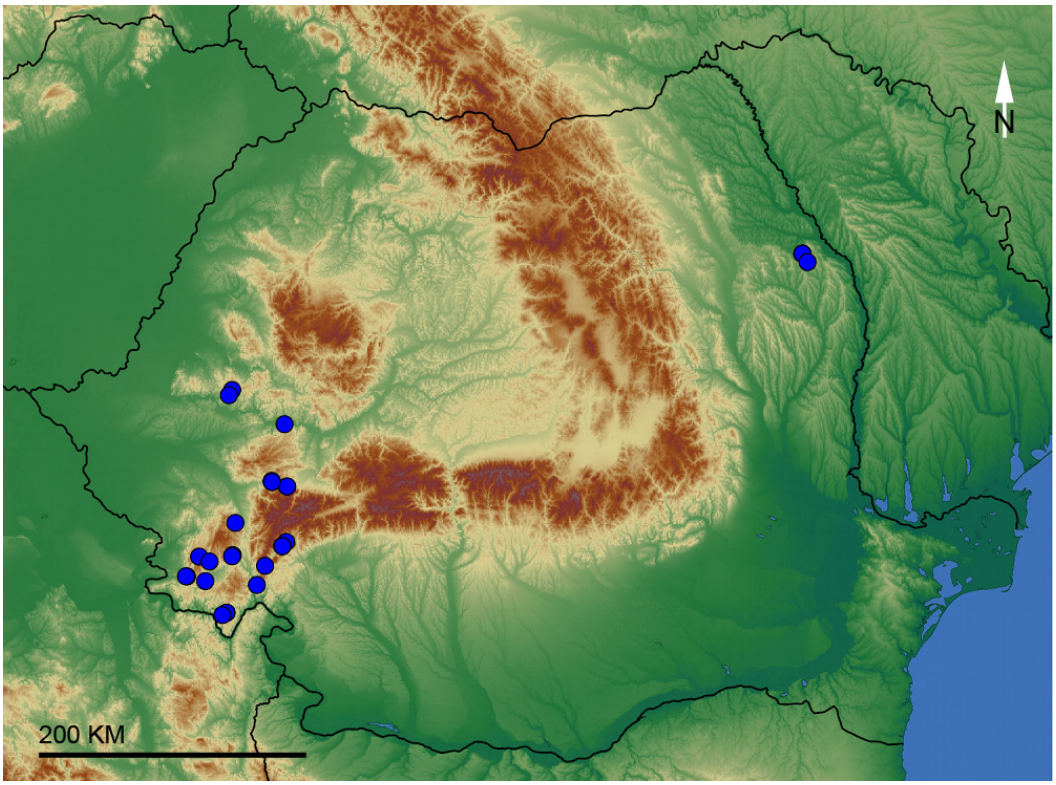

Fig. 53. Distribution map of *Cordulegaster heros*

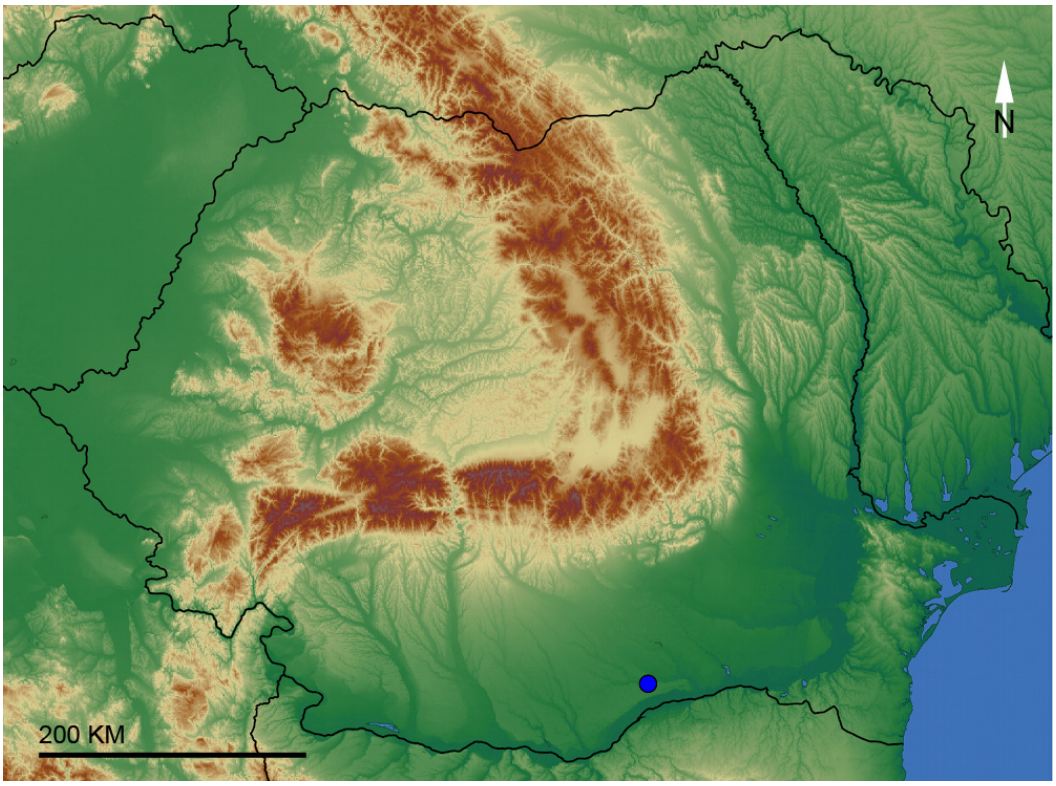

Fig. 54. Distribution map of *Cordulegaster insignis*

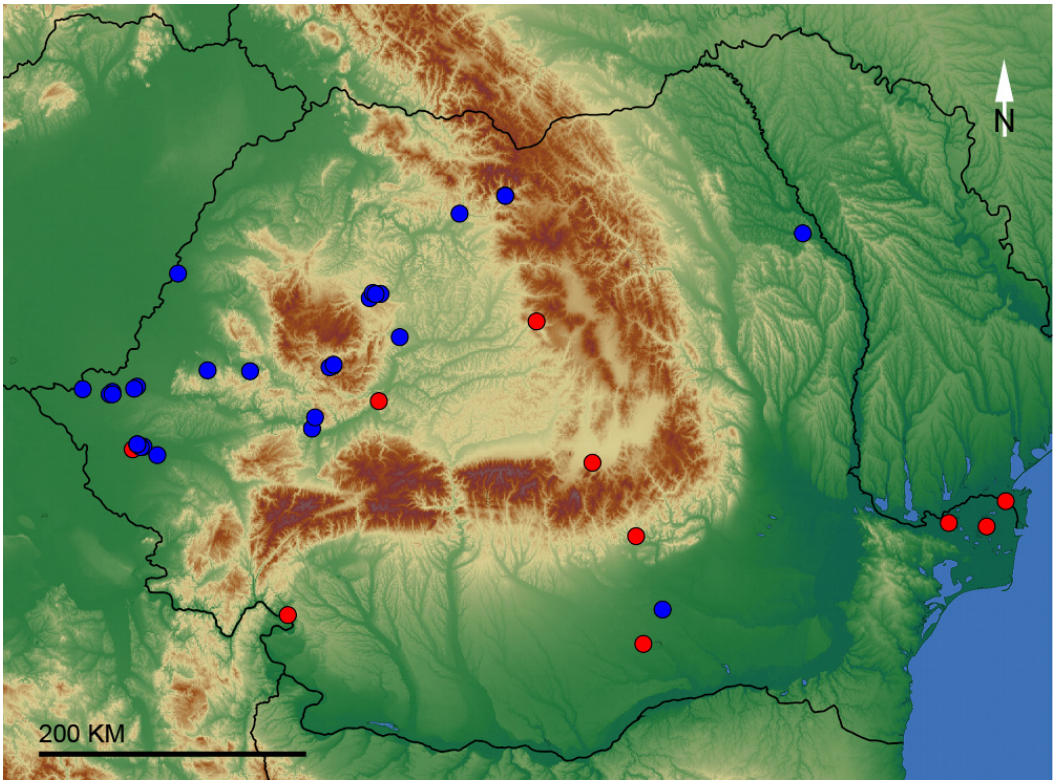

Fig. 55. Distribution map of *Cordulia aenea*

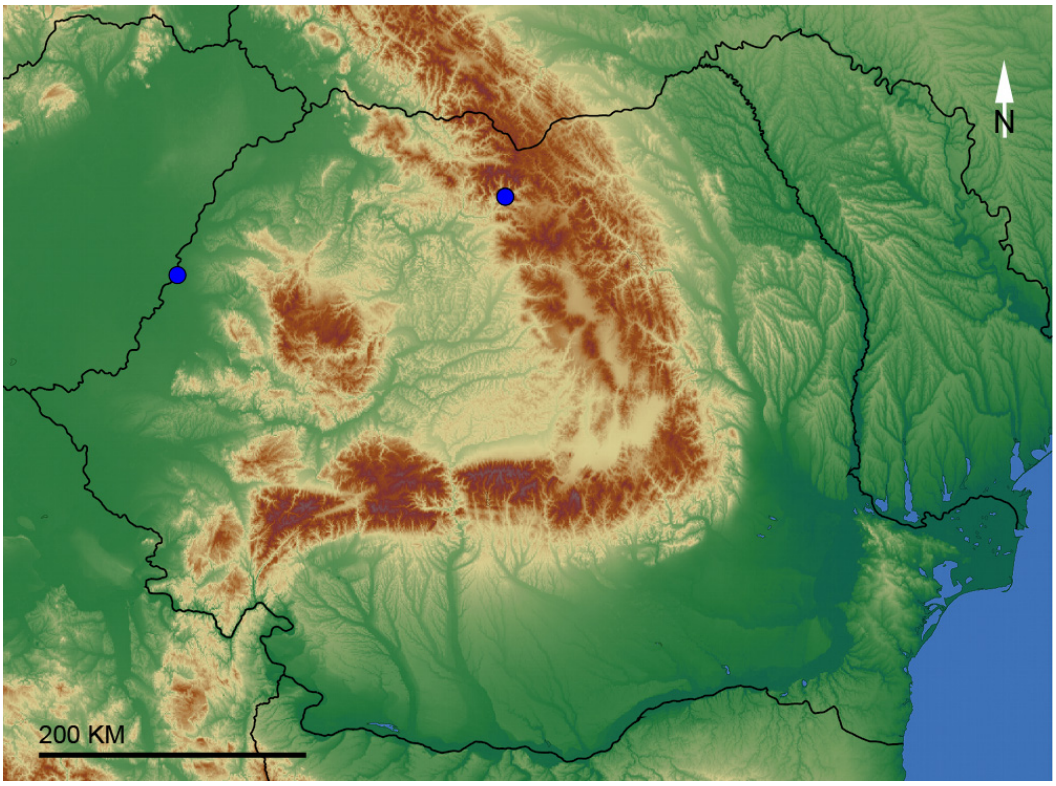

Fig. 56. Distribution map of *Epitheca bimaculata*

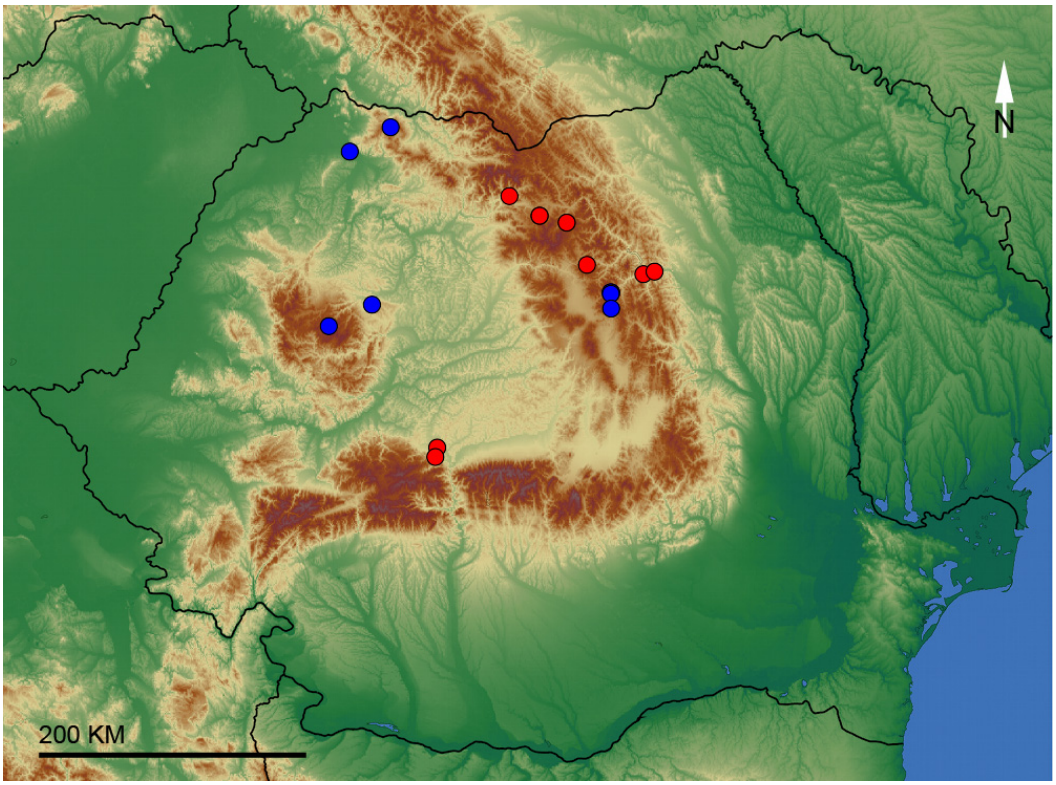

Fig. 57. Distribution map of *Somatochlora metallica*

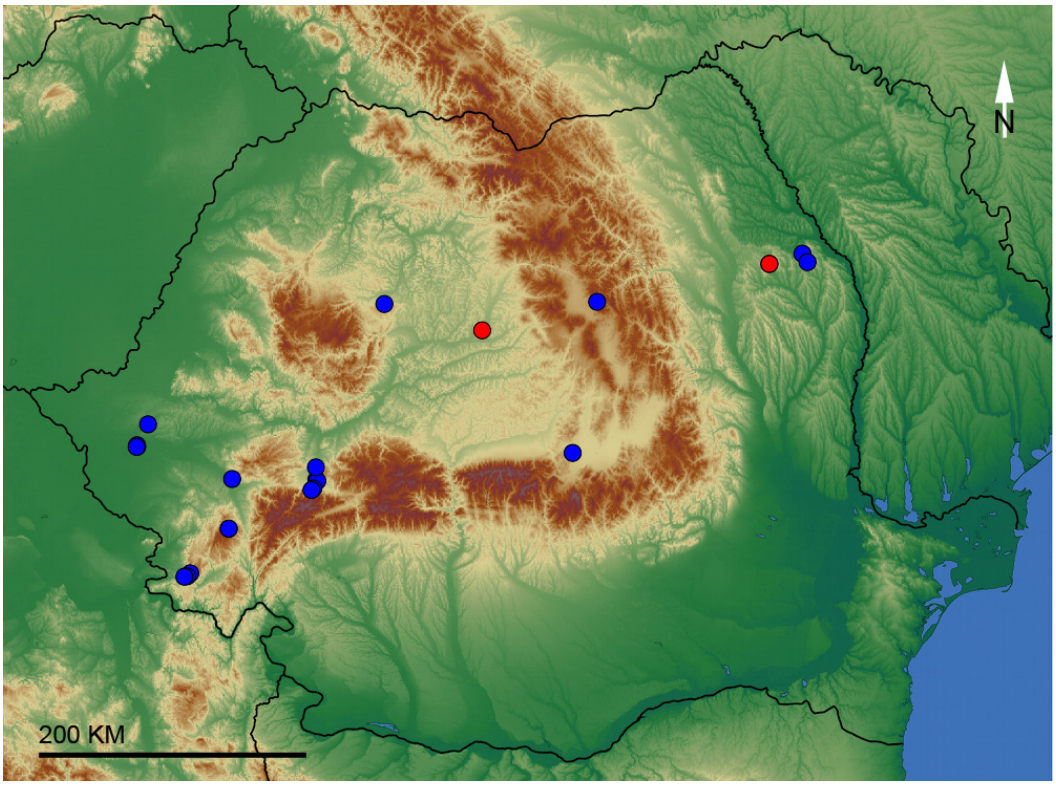

Fig. 58. Distribution map of *Somatochlora meridionalis*

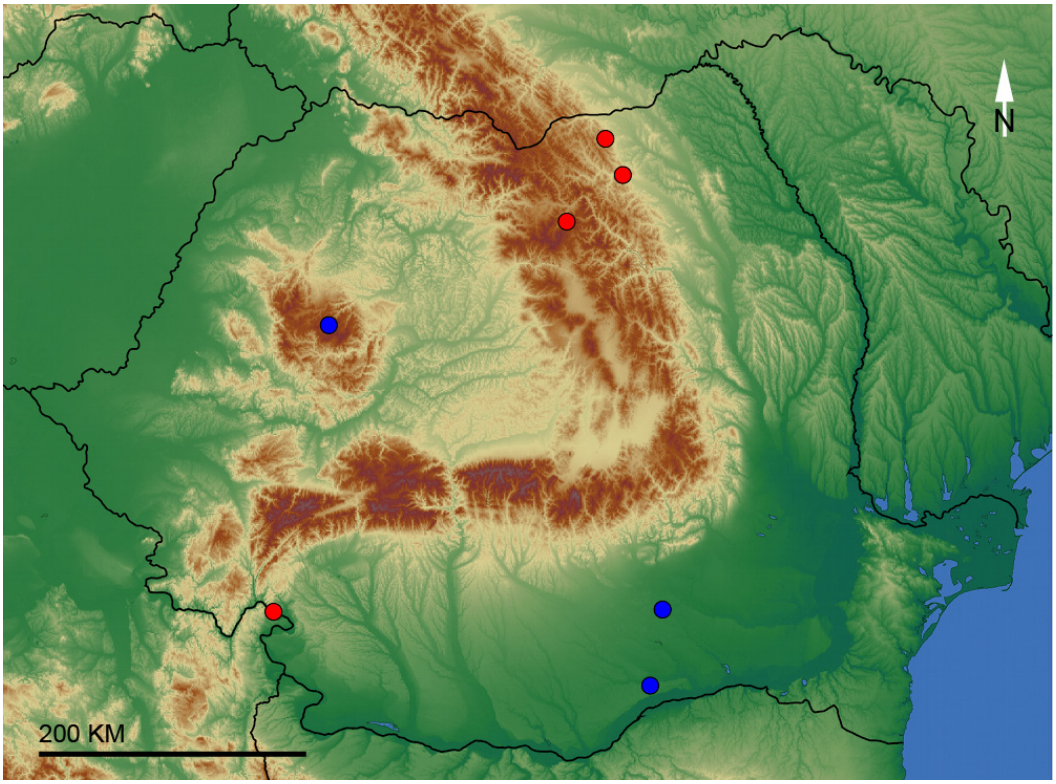

Fig. 59. Distribution map of *Somatochlora flavomaculata*

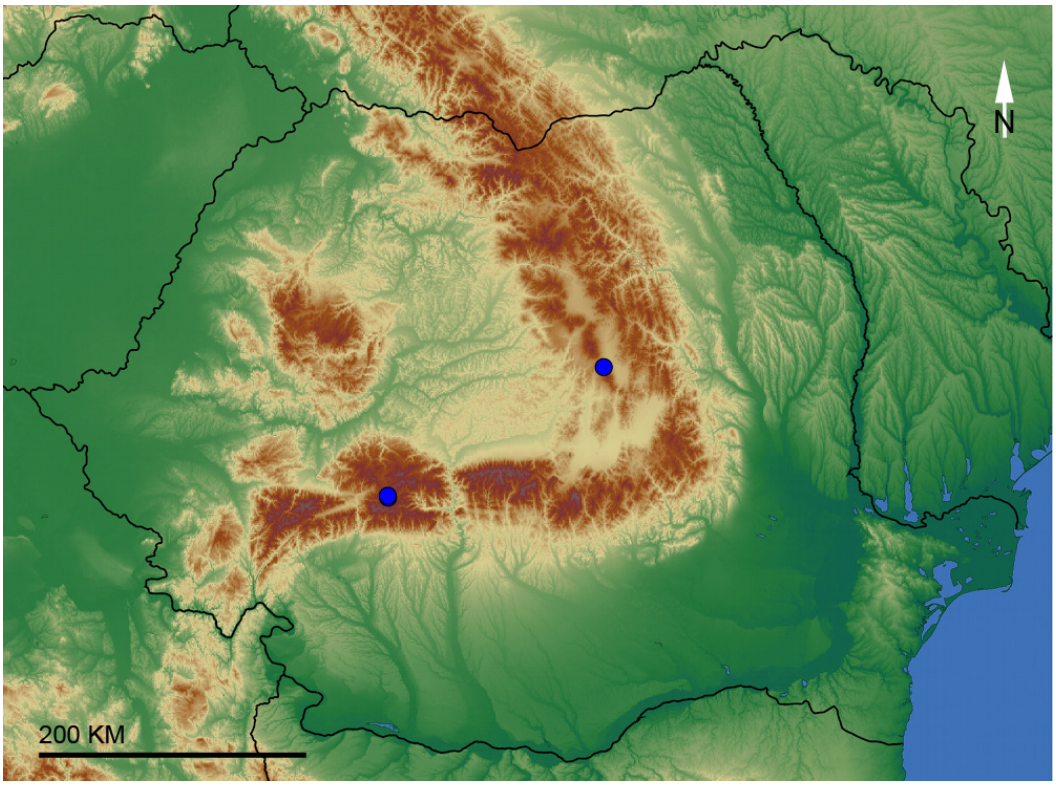

Fig. 60. Distribution map of *Somatochlora arctica*

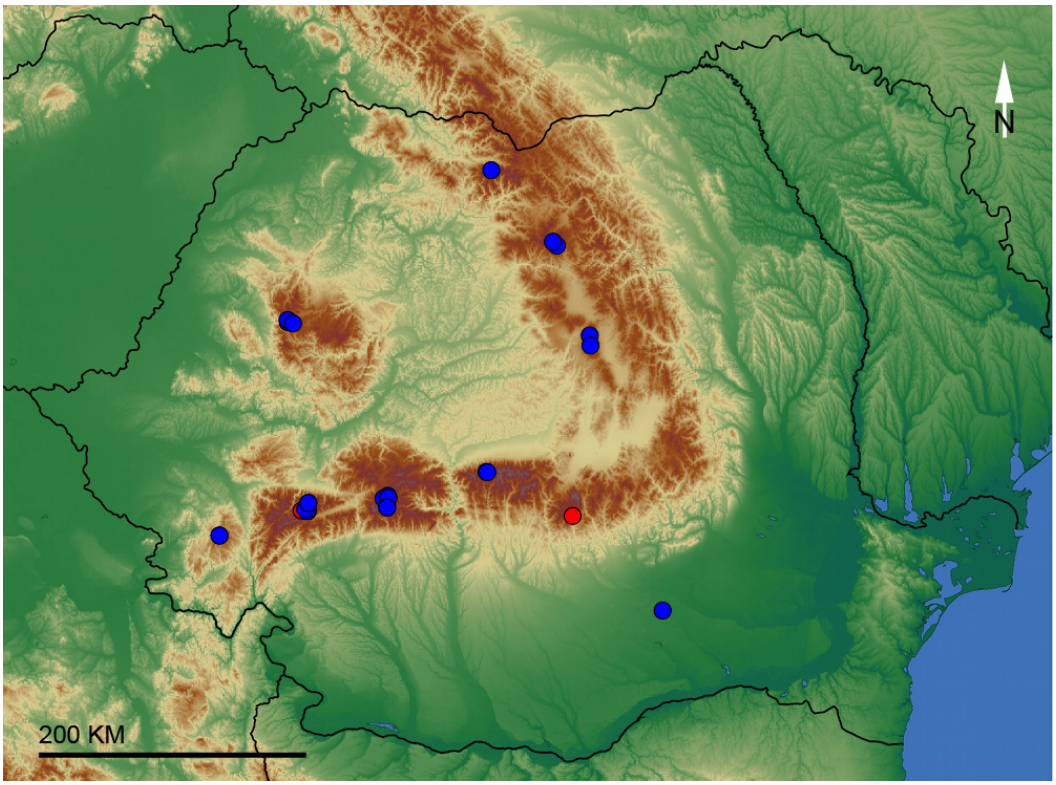

Fig. 61. Distribution map of *Somatochlora alpestris*

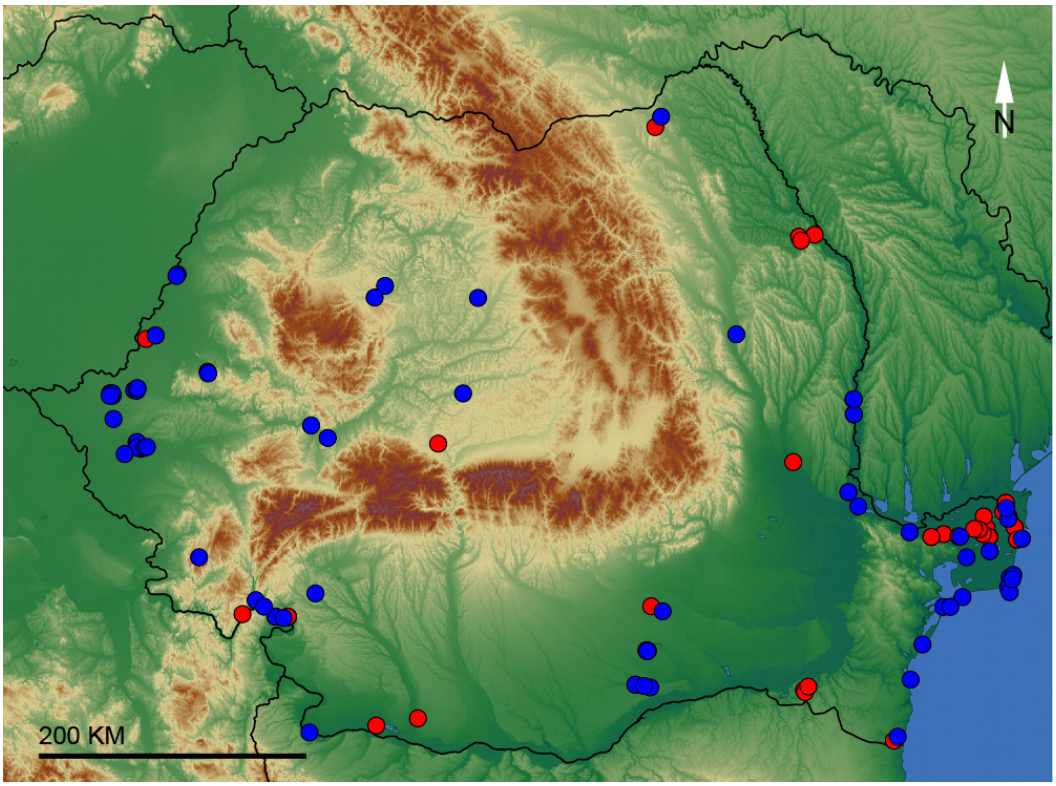

Fig. 62. Distribution map of *Crocothemis erythraea*

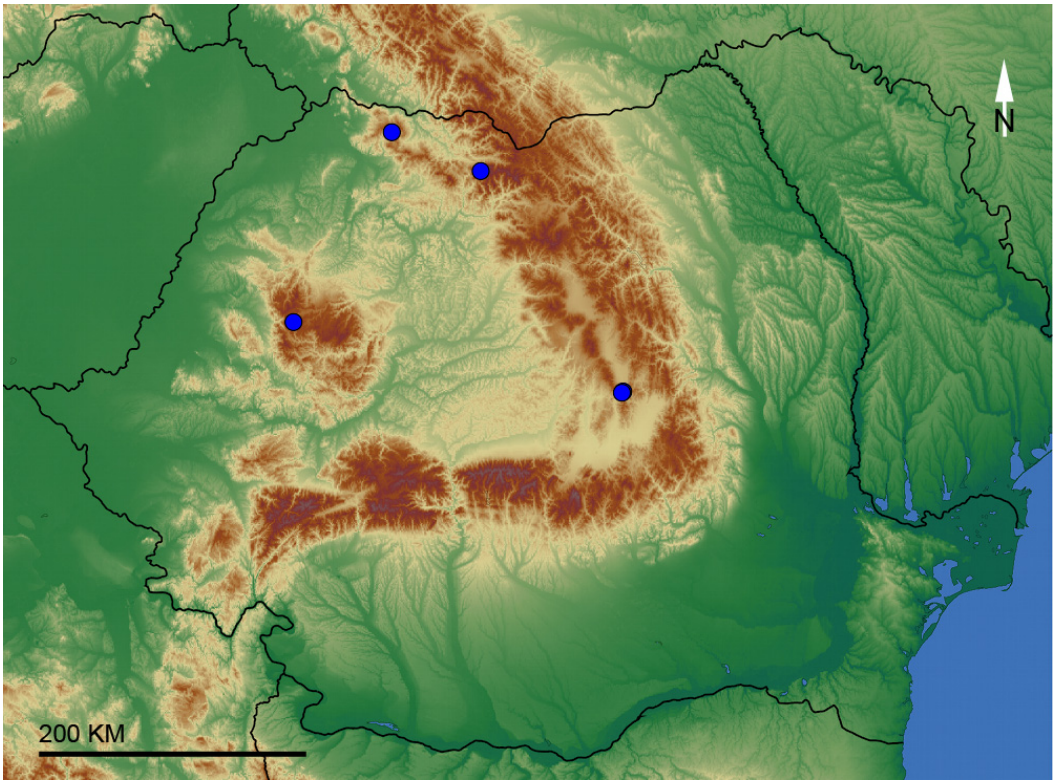

Fig. 63. Distribution map of *Leucorrhinia dubia*

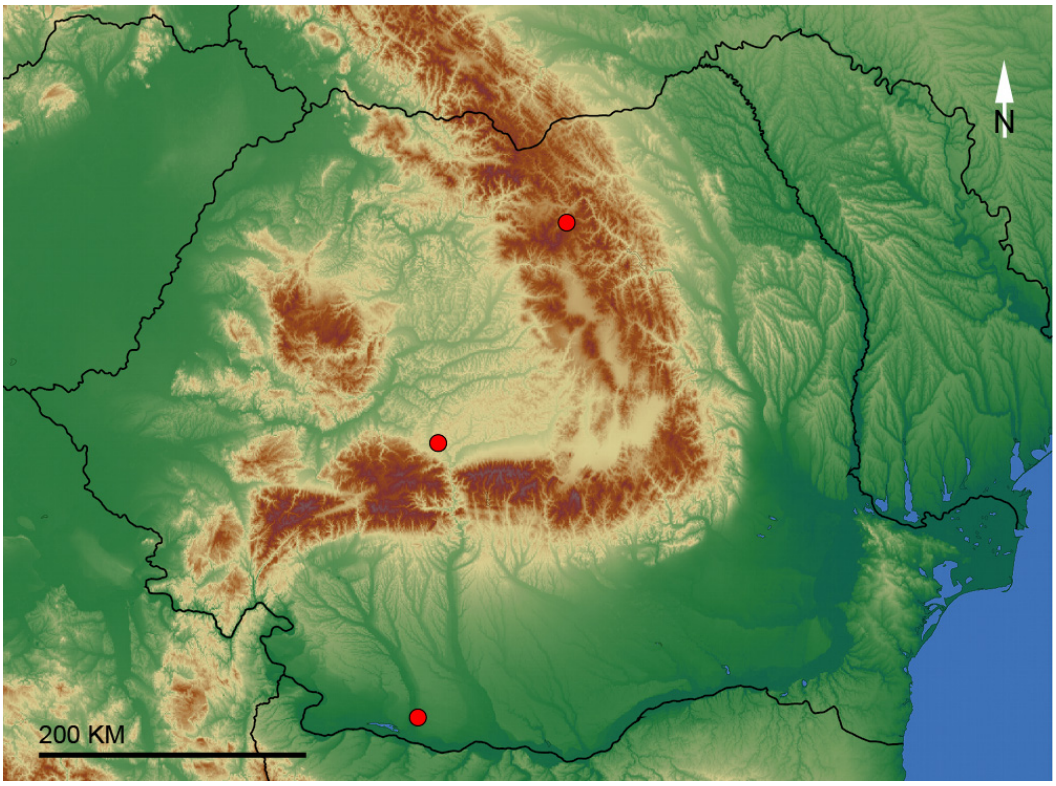

Fig. 64. Distribution map of *Leucorrhinia pectoralis*

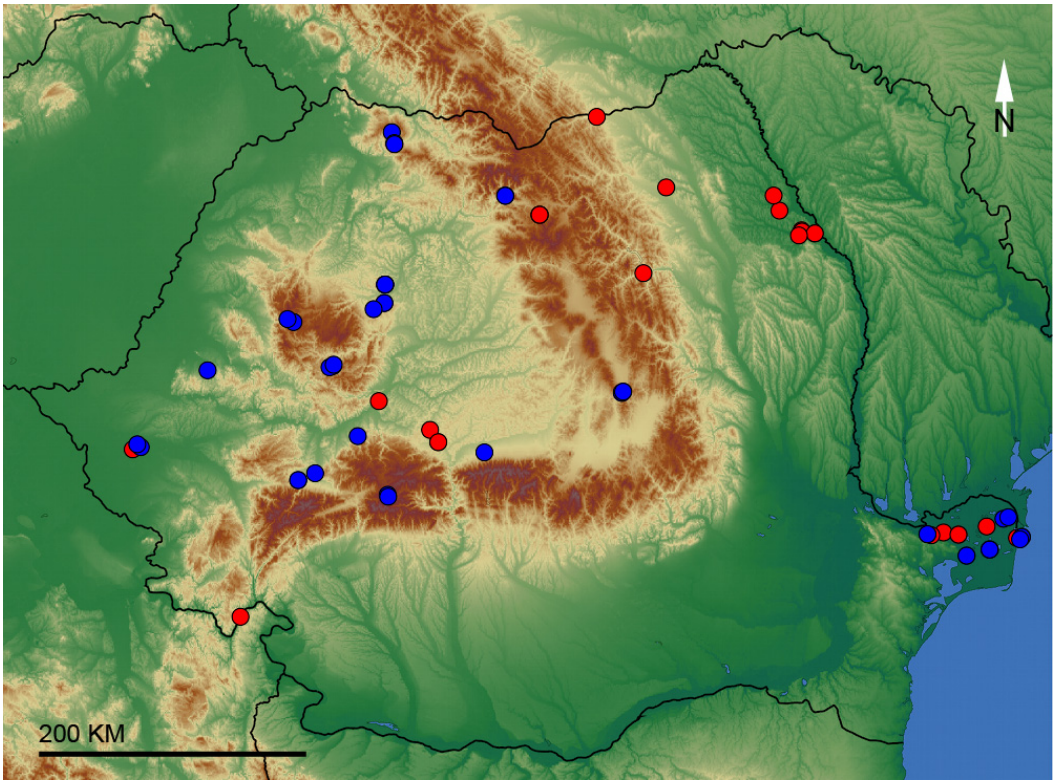

Fig. 65. Distribution map of *Libellula quadrimaculata*

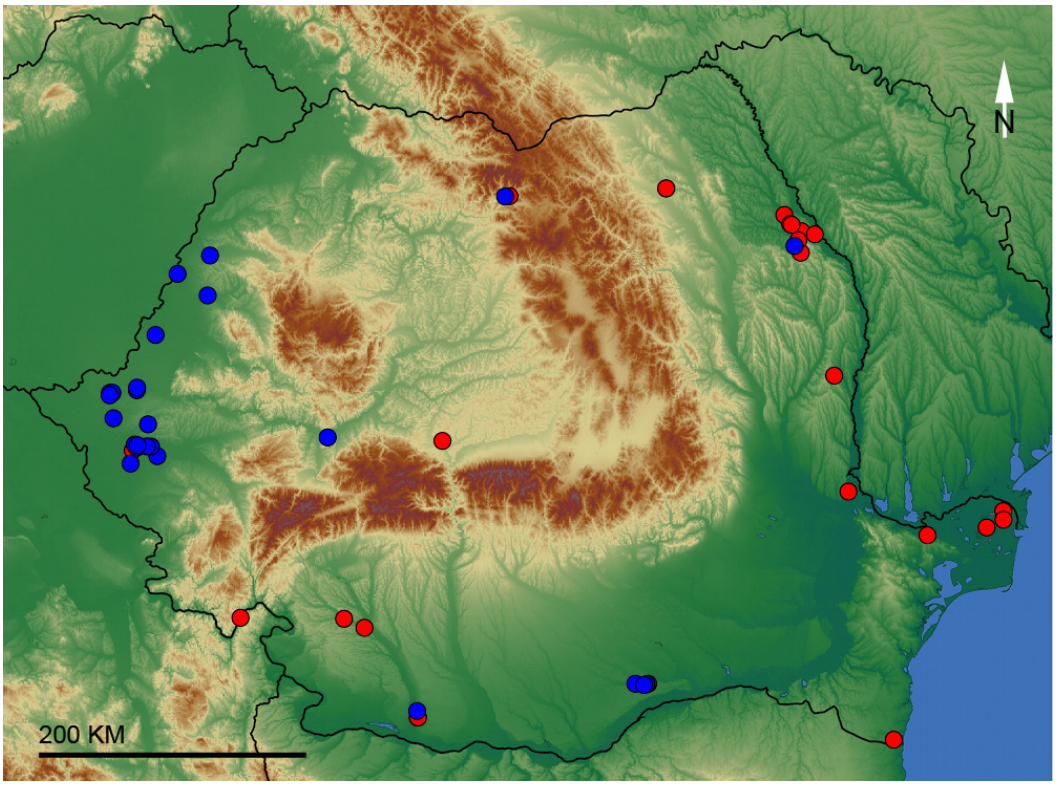

Fig. 66. Distribution map of *Libellula fulva*

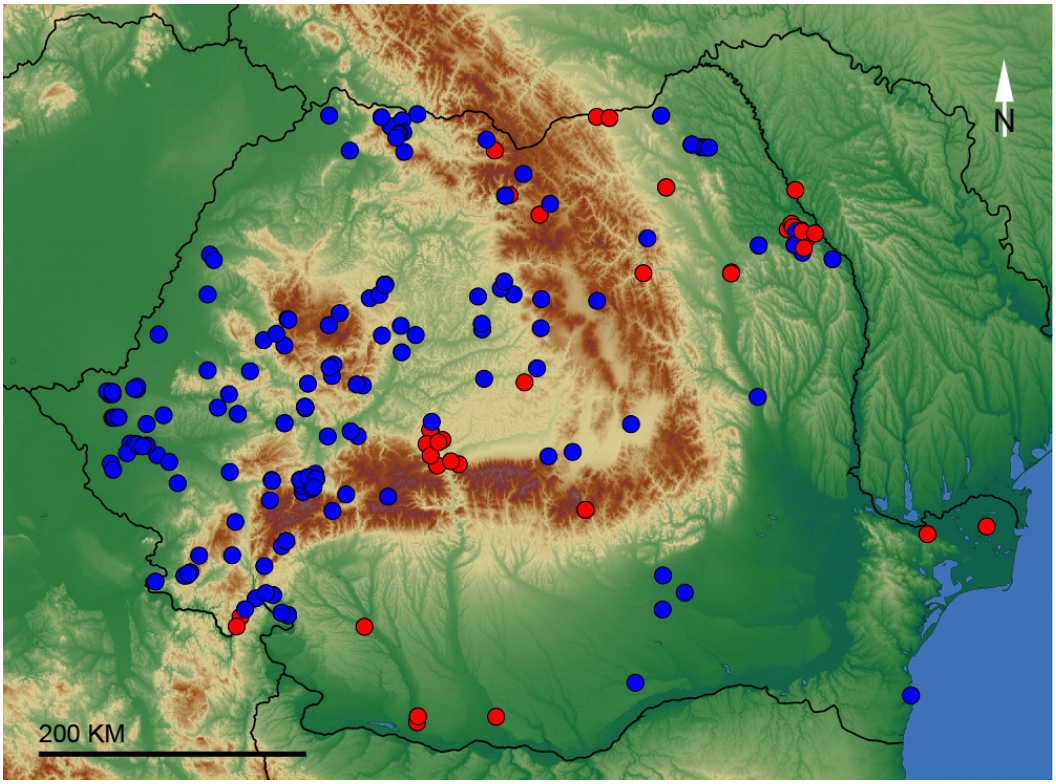

Fig. 67. Distribution map of *Libellula depressa*

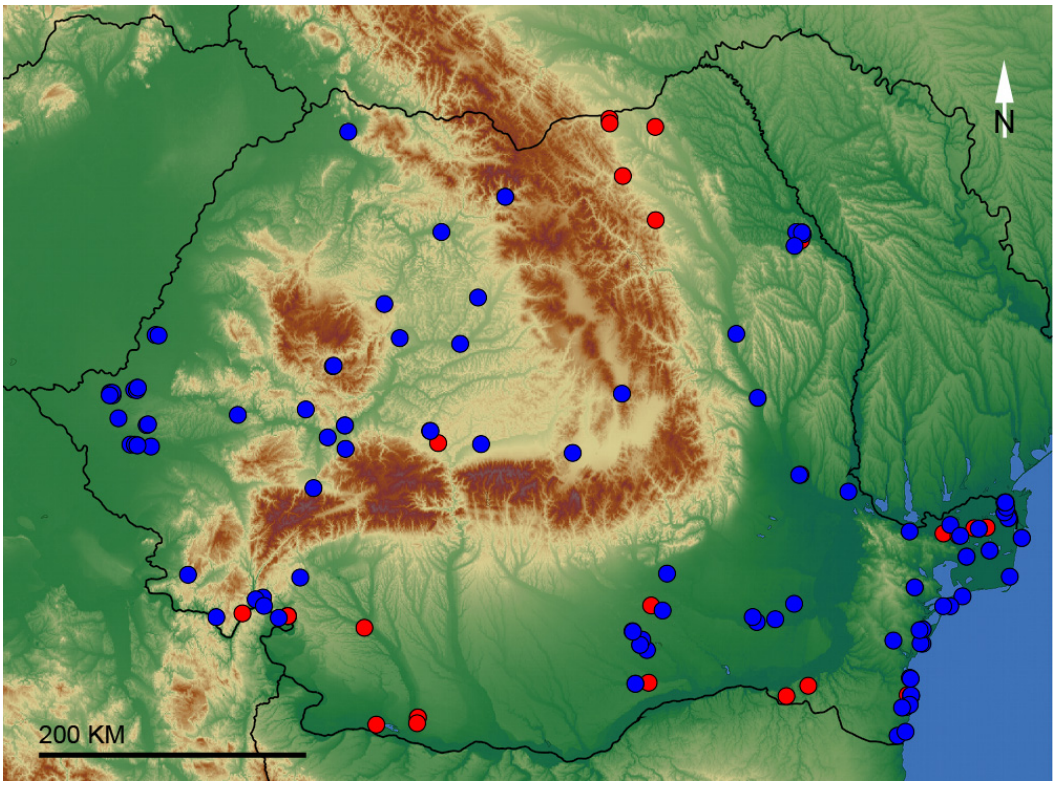

Fig. 68. Distribution map of *Orthetrum cancellatum*

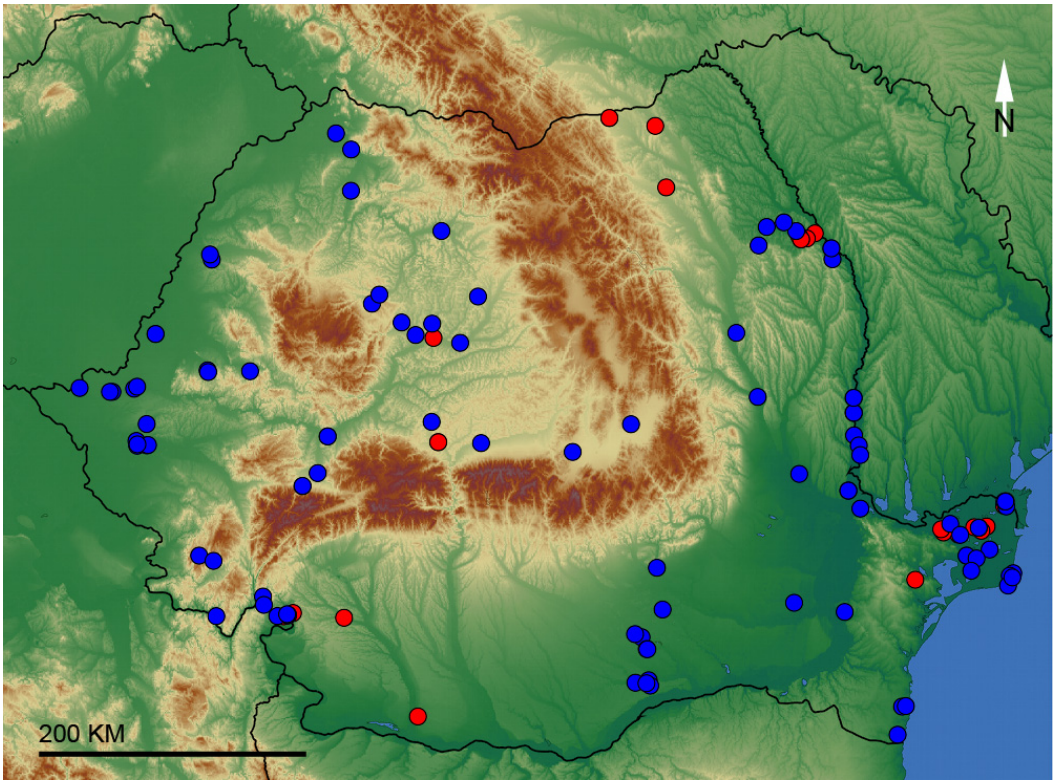

Fig. 69. Distribution map of *Orthetrum albistrylum*

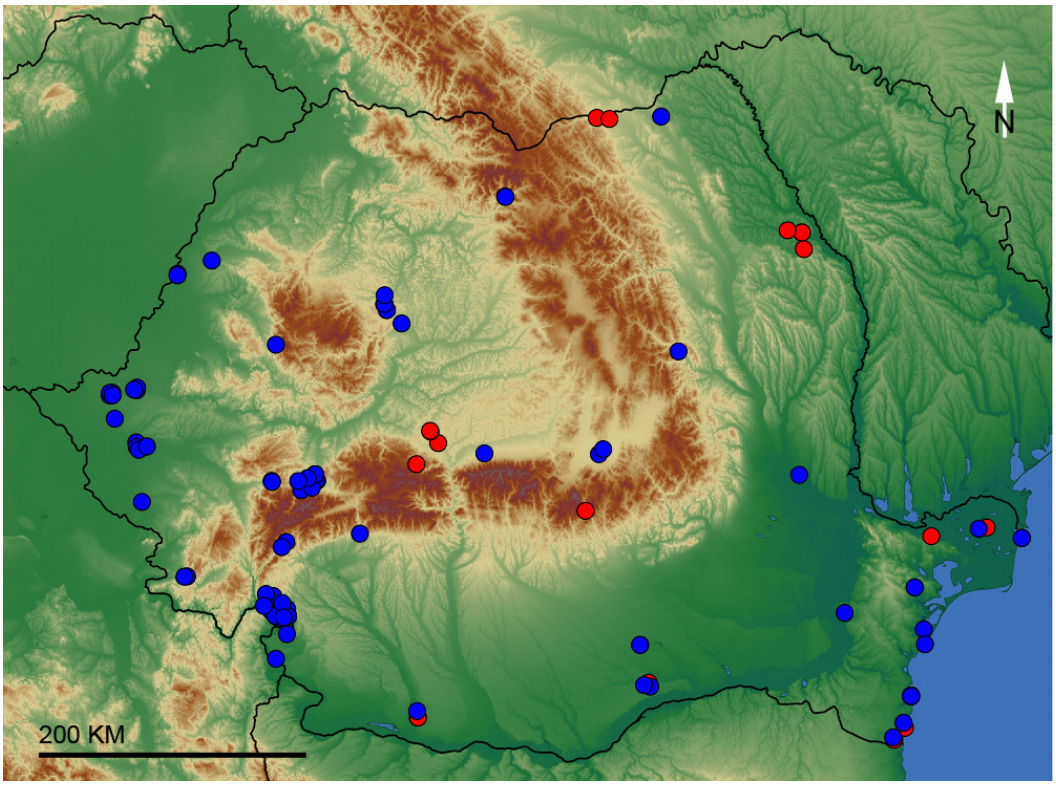

Fig. 70. Distribution of map *Orthetrum coerulescens*

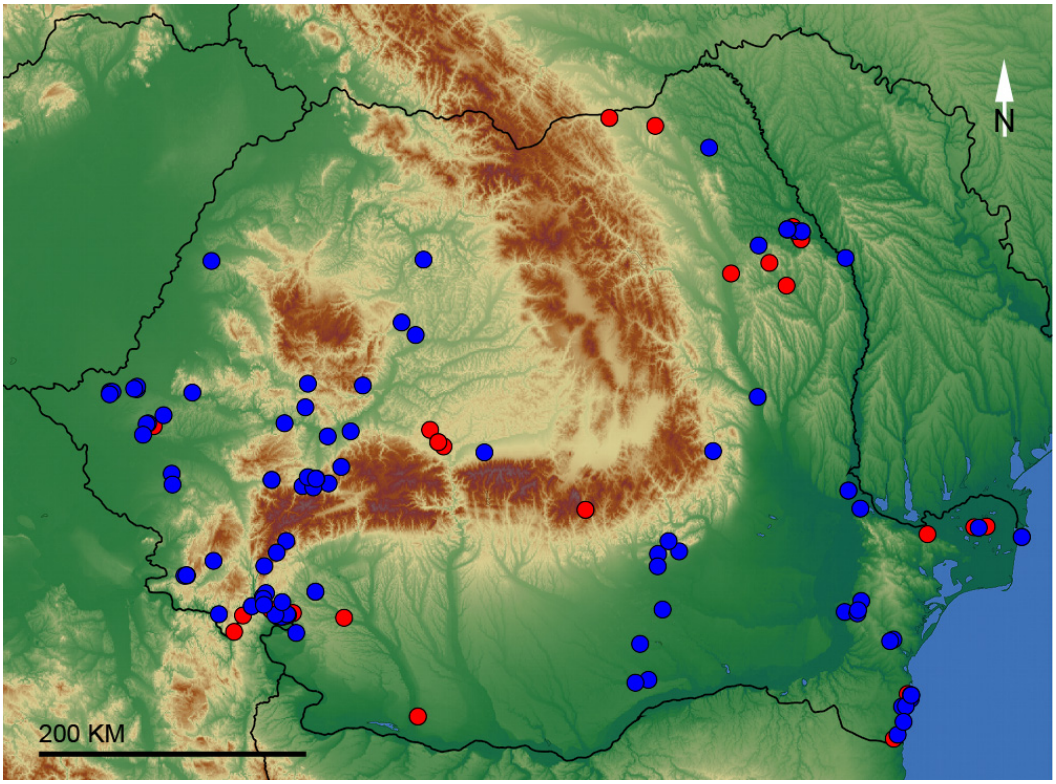

Fig. 71. Distribution map of *Orthetrum brunneum*

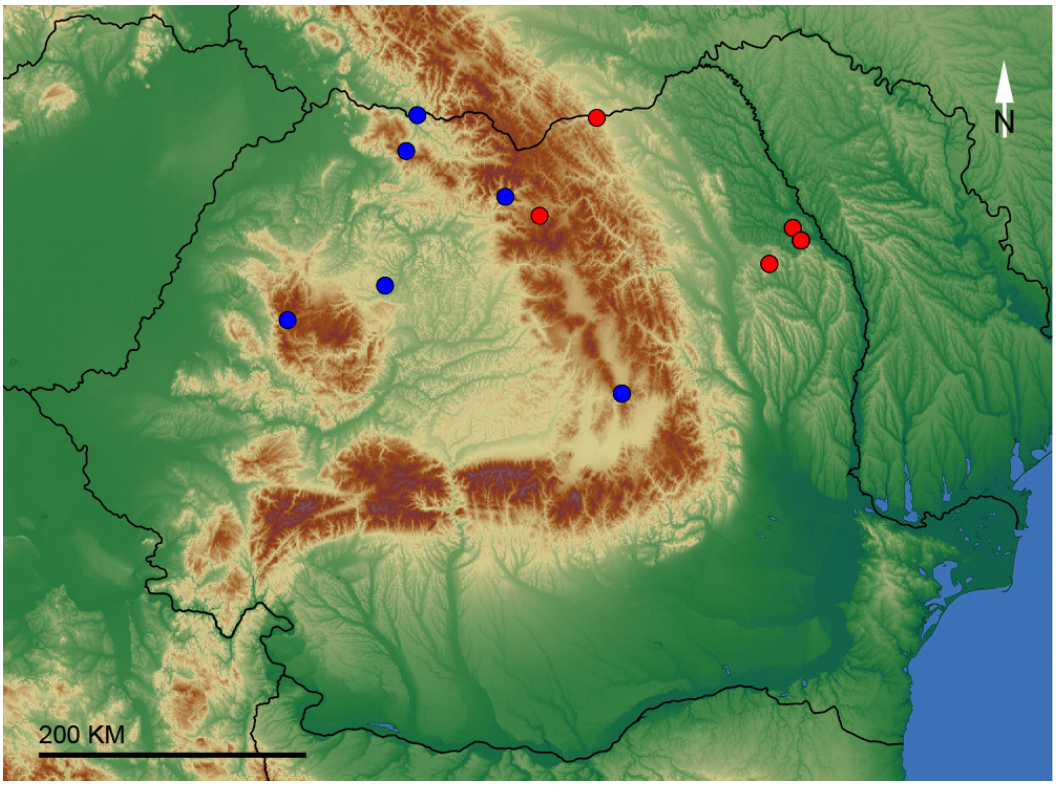

Fig. 72. Distribution map of *Sympetrum danae*

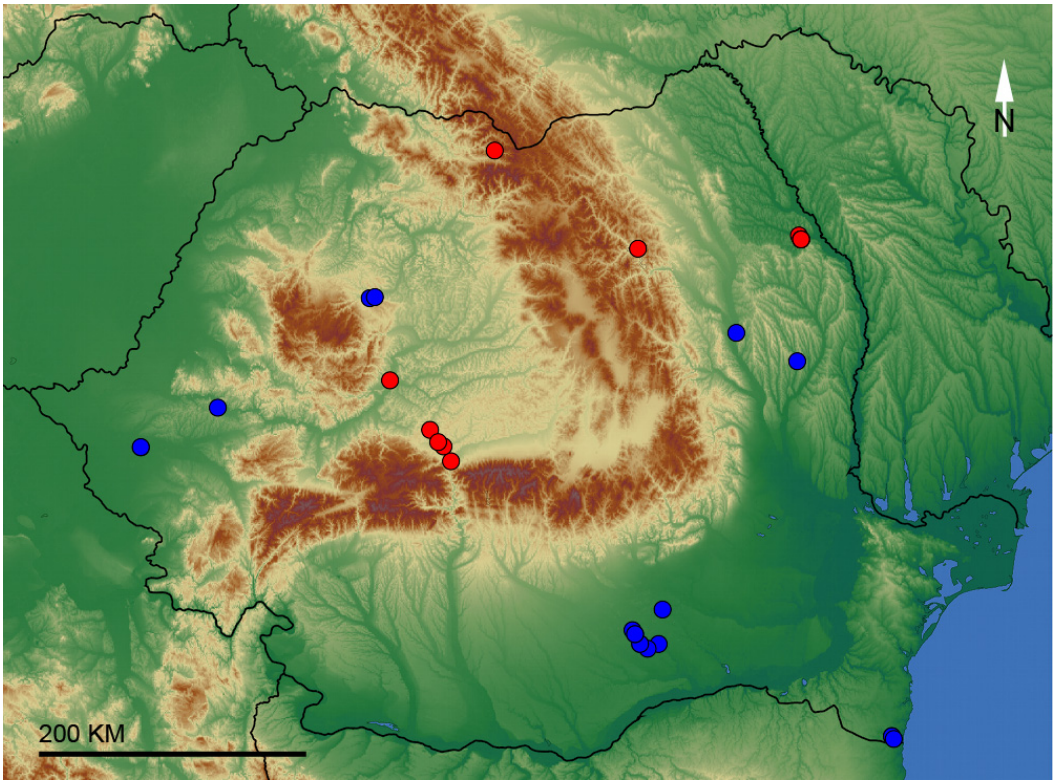

Fig. 73. Distribution map of *Sympetrum pedemontanum*

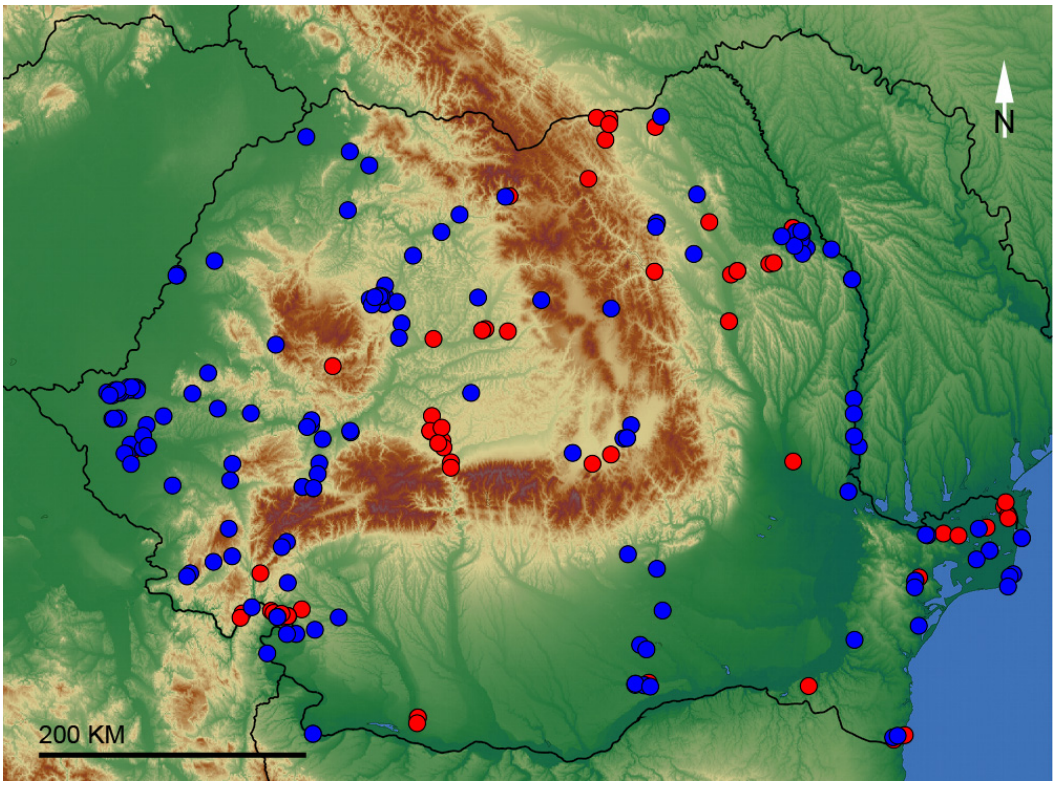

Fig. 74. Distribution map of *Sympetrum sanguineum*

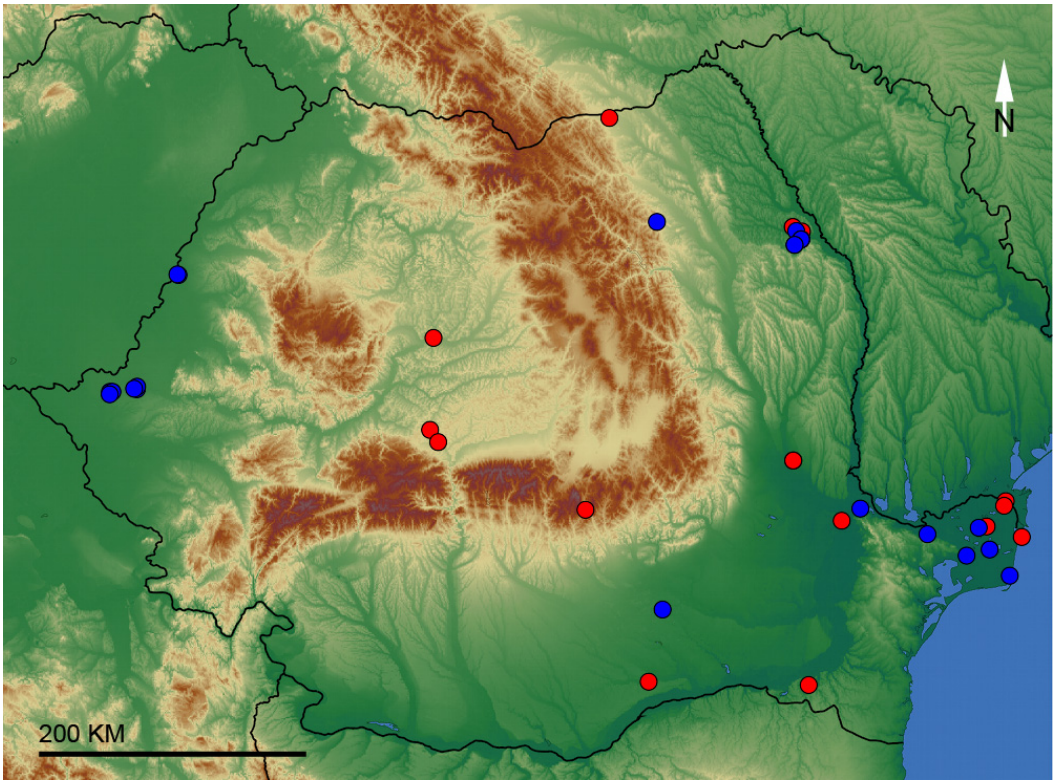

Fig. 75. Distribution map of *Sympetrum depressiusculum*

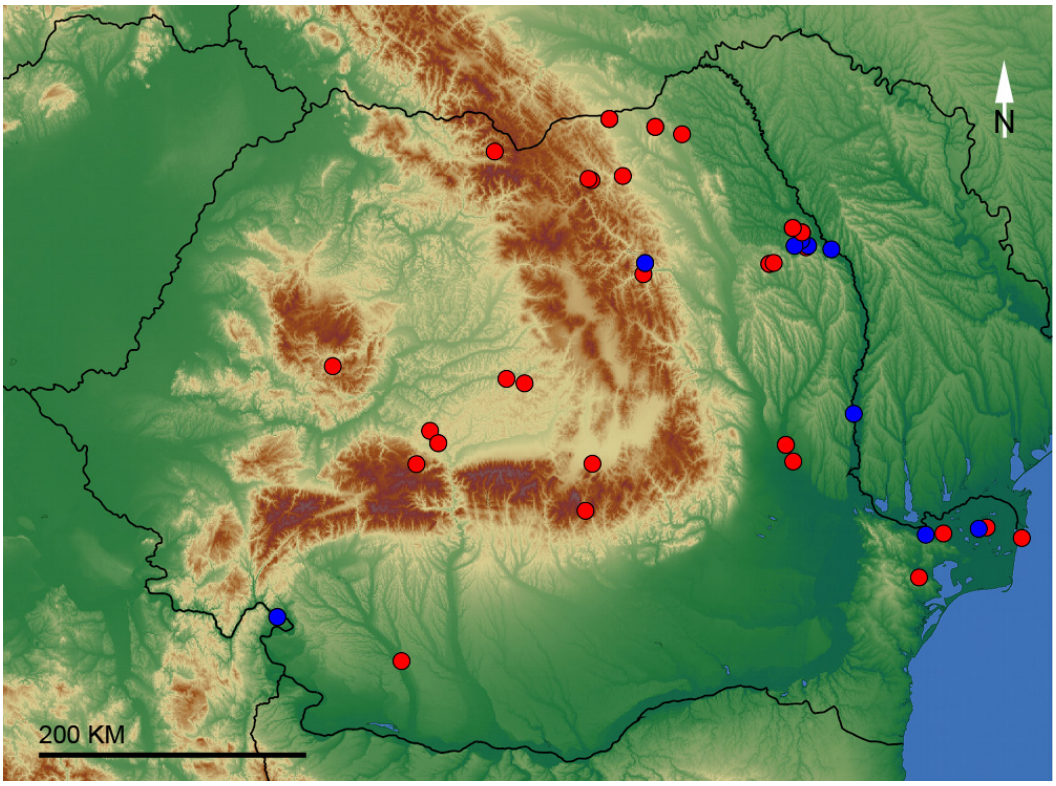

Fig. 76. Distribution map of *Sympetrum flaveolum*

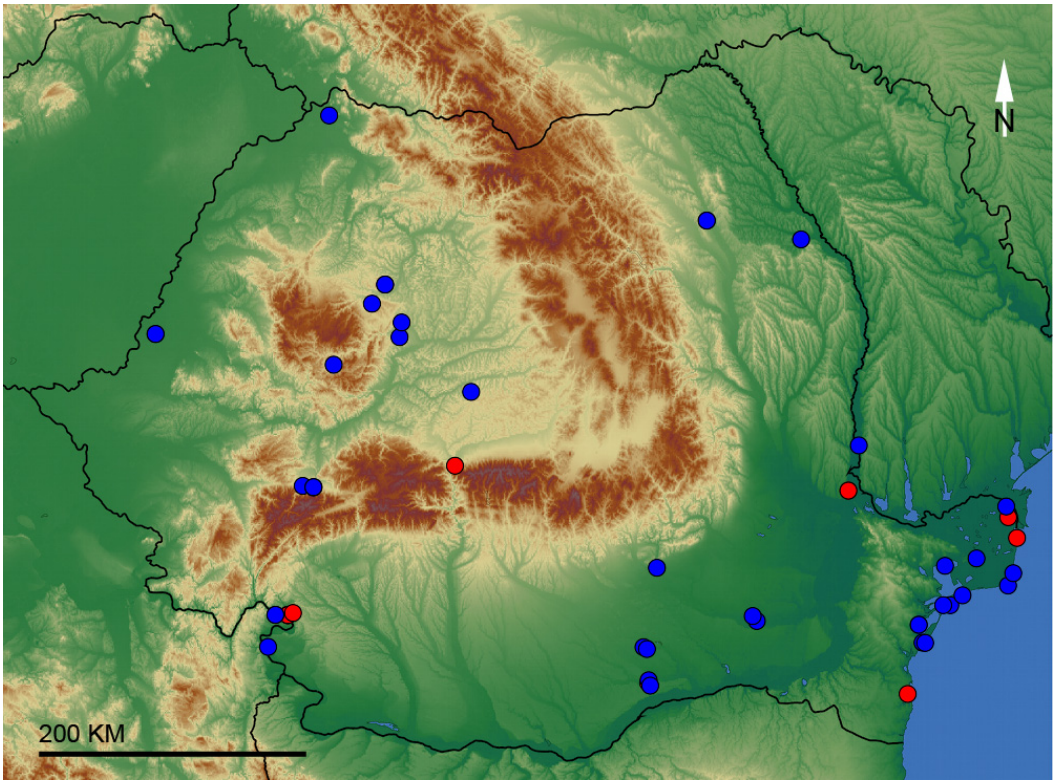

Fig. 77. Distribution map of *Sympetrum fonscolombii*

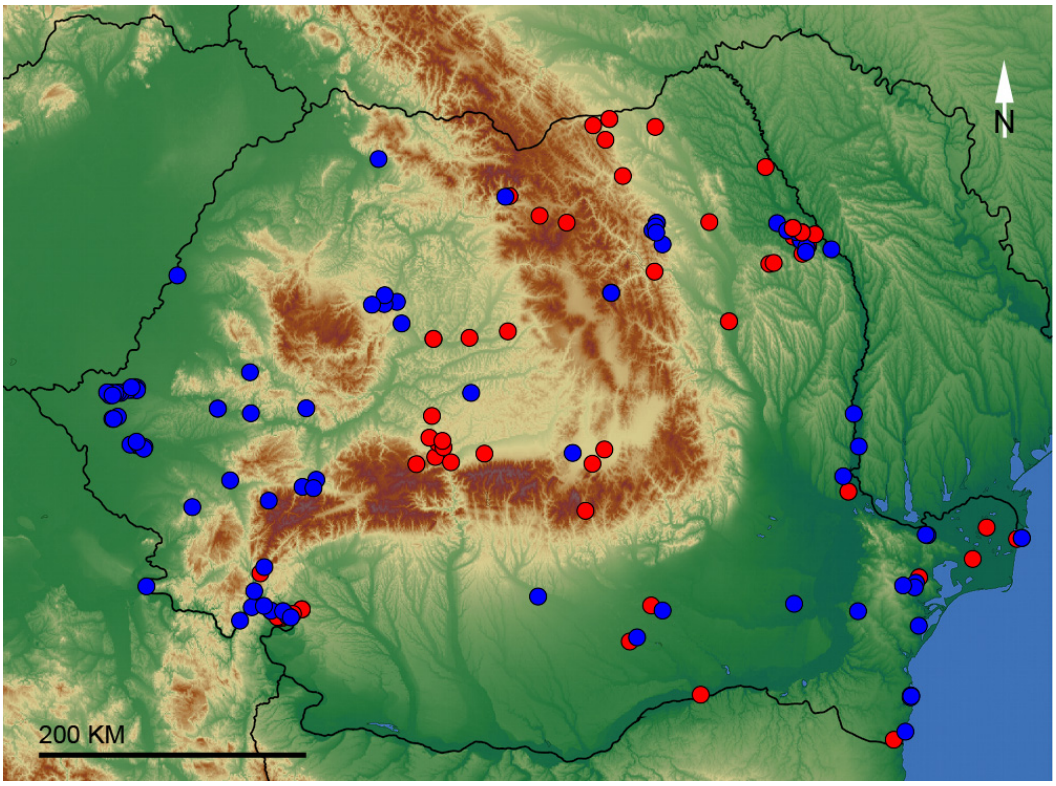

Fig. 78. Distribution map of *Sympetrum striolatum*

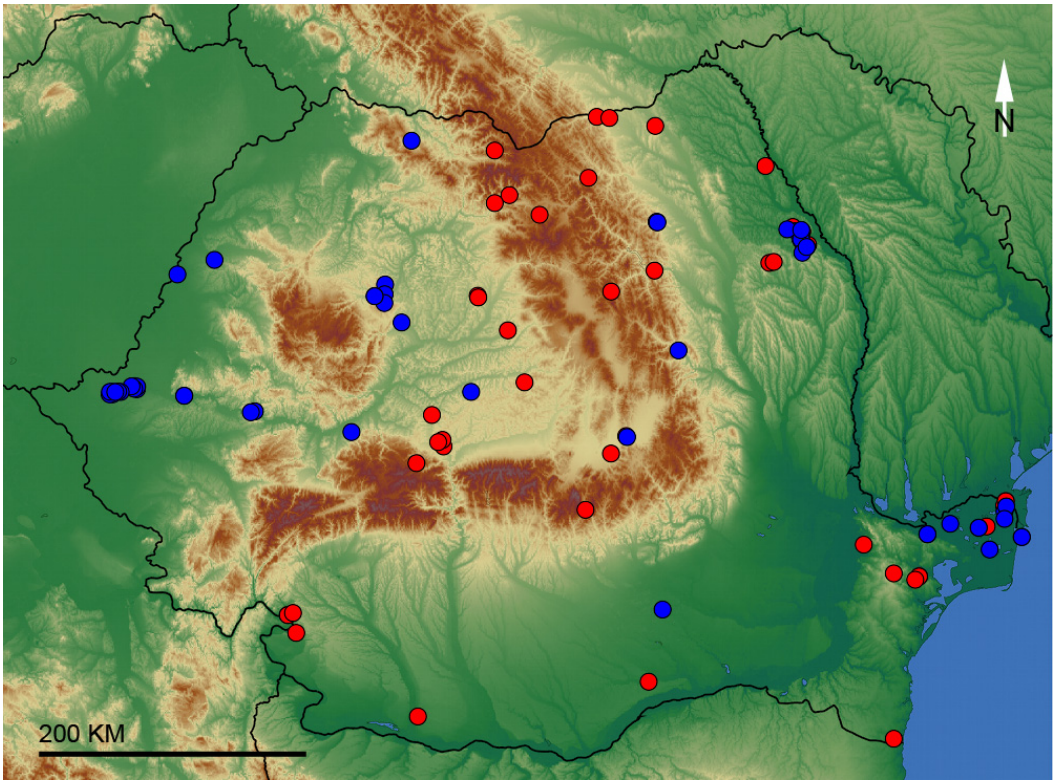

Fig. 79. Distribution map of *Sympetrum vulgatum*

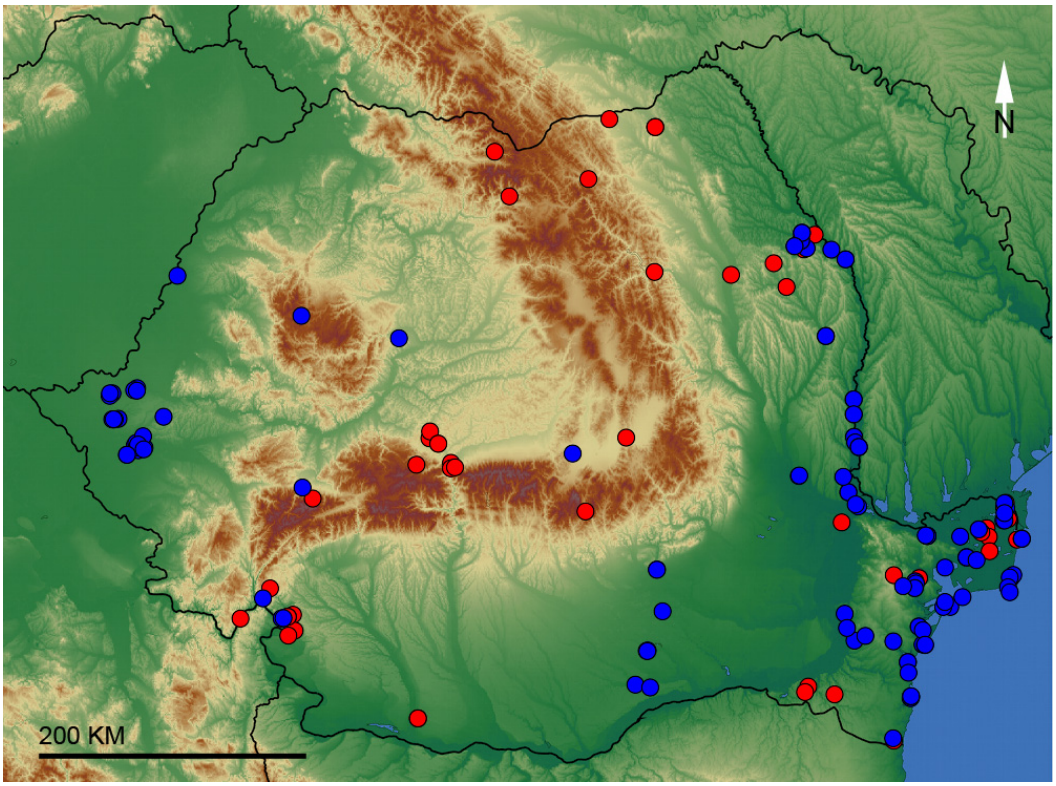

Fig. 80. Distribution map of *Sympetrum meridionale*

Results and conclusions

A database that summarizes all data in the literature studied and indexed (a small number of references could not be investigated because it was not found) these totaling about 2300 entries from the database.

The database currently totals more than 6,500 entries. Of these a number of approximately 4000 are personal collected data obtained through field trips and by studying collections which have not been the subject of publication. A total of 200 entries are data obtained from nature lovers who wanted to have their photographed dragonflies species determined.

A website in Romanian language dedicated to dragonflies was realized (http://dragonfly.nature4stock.com) which is continuously updated.

Three major public collections have been investigated so far, and for two of them a catalog was published (Manci, 2007; Manci, 2011), the catalog for the third collection being in progress. Other public collections (Timisoara, Deva and Târgu-Mures) or private (Vicol Vasile, Marin Goia) were investigated without a stand-alone publication due to the small size of the collection (tens of individuals).

The status of 84 species was studies, from these:

- ✓ We can consider 70 species as present on the territory of Romania, but two of them were not reported anymore for over 50 years and their status is unknown (*Coenagrion armatum*, *Leucorrhinia pectoralis*), and a third species (*Anax ephippiger*) arrives in Romania only due to irregular migrations;
- ✓ 7 species (*Epallage fatime*, *Sympecma paedisca*, *Aeshna caerulea*, *Aeshna viridis*,*Caliaeschna microstigma*, *Cordulegaster picta*, *Leucorrhinia caudalis*) can be considered possible to be found on Romanian territory, known populations being in neighboring countries within 50 km from our borders;
- ✓ The presence of 7 species (*Ceriagrion tenellum*, *Coenagrion caerulescens*, *Coenagrion mercuriale*, *Gomphus pulchellus*, *Onychogomphus forcipatus*, *Cordulegaster boltonii*, *Crocothemis servilia*), in Romania, is questionable all these species being spread exclusively in Western Europe or Asia and could not be found in the collections studied.

As a result of researches conducted at national level on dragonflies we can draw some conclusions.

Fauna:

- ➢ *Somatochlora arctica* was identified as new for Romanian fauna (De Knijf & all, 2011);
- ➢ *Epitheca bimaculata* was identified as new for Romanian fauna and a broader study is being finalized for publication (Manci & Bazga, work in progress);
- ➢ *Nehalennia speciosa* considered vanished from Romania (Bernard & Wildermuth, 2005) was rediscovered in 2009 and a broader study is undergoing work (Manci, work in progress);

- A population of the species *Cordulegaster heros* was discovered in Moldova at hundreds of kilometers away from any known data in Europe, this being the most eastern population known of the species (Manci, 2011);
- The status of 84 species was discused;
- many species considered to be very rare in Romania following research could be found in a larger number of localities (*Lestes macrostigma*, *Lestes parvidens*, *Coenagrion scitulum*, *Erythromma lindenii*, *Pyrrhosoma nymphula*, *Aeshna juncea*, *Somatochlora alpestris*, *Sympetrum fonscolombii*).

Distribution:

- for 70 species distribution maps have been created based on literature data, private collections or publics and personal datas;
- the most frequent species on the country's territory are *Coenagrion puella* and *Libellula depressa* these being found from the sea coast until over 1300 meters altitude, and their distribution is certainly larger than what can be seen on the distribution maps;
- The most "plastic" species found is *Enallagma cyathigerum* this being observed during reproduction in the brackish lakes from sea coast, salted lakes from Muntenia or Transylvania but also in the acid lakes from the higher altitude area, the maximum altitude being of 1740 m (Tăul dintre Brazi from Retezat Mountains);
- The distribution maps have been generated with the help of specific web applications found in the resource toolkit-ul of **Nature Digital Object Repository** at the adress **http://mybiosis.info/**, having as a parting point the created database.

Ecology:

- Some species (*Lestes viridis*, *Lestes parvidens*, species of *Somatochlora*, species of *Cordulegaster*) have been observed a longer lenght of time and are the object of future research.

For the future:

- ✓ publishing catalogs of all public collections from the country when the size of the collection makes it necessary to create an independent publication;
- ✓ publishing a monograph work of Romanian fauna;
- ✓ further studies for the species *Lestes viridis* and *L. parvidens;*
- ✓ further studies for the species *Somatochlora meridionalis* and *S. metallica;*
- ✓ further studies for the species *Cordulegaster* with emphasis on *C.heros*, in Romania*;*
- ✓ further studies for the species *Orthetrum coerulescens*.

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Manci, C.O. - Dragonflies (Insecta: Odonata) in Timis county, a general view of distribution

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