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ORIGINAL ARTICLE

Biotopic distribution of Lady Beetles (Coleoptera, Coccinellidae) in the central part of Western Siberia (Russia)

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The species diversity of Coccinellidae in the central part of Western Siberia is represented by 36 species belonging to 6 tribes and 22 genera. The peculiarities of Coccinellidae distribution into 12 biotopes is caused by the relief uniqueness, floral richness and anthropogenic influence. In forest formations, the species composition of Coccinellidae in mixed, pine-spruce-birch and pine-birch forests is the most abundant, with 23, 19, and 15 species of lady beetles, respectively.
Key words: biotopic distribution; Coccinellidae; Coleoptera; lady beetles; Western Siberia

Introduction

Lady Beetles (Coleoptera, Coccinellidae) are the most efficient economically important predators among the Coleoptera families. They destroy aphids, scabs, psyllas, scales, whiteflies, thrips, spider mites, eggs and larvae of leaf beetles and other small insects. Thus, lady beetles are considered natural regulators of numerous pests population in agriculture and forestry.
In addition, lady beetles are characterized by feeding on a variety of vegetation and a high search and selective ability. Numerous Coccinellidae species have wide ecological plasticity and are met in different biotopes of zonal, azonal and anthropogenic ecosystems.
The association of Coccinellidae with certain biotopes in various regions was studied by numerous scientists (Kuznetsov, 1993, 2006; Binkovskaya, 2004; Pekin, 2007; Butko, 2009; Tyumaseva, 2013, 2016). But the central part of Western Siberia remained poorly studied in this respect until present.
This research is aimed to detect the biotopic distribution of Coccinellidae in typical biotopes of the studied region.

Materials and Methods

Studies on the Coccinellidae biotopic distribution and their association with certain ecosystems of Western Siberia were conducted stationary and semi-stationary in various biotopes in 2003–2011, single collections were also performed around the cities Lyantor, Surgut, Nefteyugansk, Megion, Langepas, Kogalym, Nizhnevartovsk; in the vicinity of the settlements Barsovo, Pyt'-Yakh, Saigatina, Lokosovo and Salym oil field in 2009–2015.
To study the species diversity, the Coccinellidae were collected by mowing the butterfly net in the shrub and grass vegetation. Collections from trees were made by mowing the crowns. Quantitative accounting of lady beetles in different biotopes and agrocenoses of this region was carried out according to generally accepted methods. The species were identified using different manuals (Reikhardt, 1948; Bielawski, 1984; Kuznetsov, 1992). The Coccinellidae species were divided into “rare”, “common” and “mass”, basing on the following percentage: the species constituting in the total collection of Coccinellidae less than 1% of specimens were considered “rare”; the species constituting 1–10% of all the collected lady beetles were considered “common”; the species with a larger number of specimens in the collections were called “mass” (Tyumaseva et al., 2010).
The total amount of the examined material was 3850 adult specimens of Coccinellidae. All the collected material is deposited in the private collection of Z.I. Tyumaseva (Chelyabinsk).

Results

The eco-faunistic study was performed in zonal, azonal, anthropogenic, and anthropogenically transformed natural ecosystems in the central part of Western Siberia. As a result of the entomological research, 36 Coccinellidae species belonging to 6 tribes and 22 genera have been revealed. 12 typical biotopes united in similar groups by landscape characteristics were identified on the examined territory.

In the zonal ecosystem of middle taiga of Western Siberia, we have studied 2 groups of biotopes: mixed and dark coniferous forests.

Mixed forests are characterized by moderate humidity and have well expressed stratification. The tree stratum is dominated by *Picea obovata*, *Pinus* (Pinaceae) and *Betula* (Betulaceae). The shrub stratum is represented by *Sorbus, Rosa* (Rosaceae), *Sambucus (Adoxaceae)*. Among the prostrate shrubs one can meet *Ledum, Vaccinium vitis-idaea, V. uliginosum* (Ericaceae), *Rubus saxatilis* (Rosaceae). The herbaceous cover is inconsistent, with a local distribution of the herbage-reed association. Among the flowering plants, *Maianthemum* (Asparagaceae), *Galium* (Rubiaceae), *Oxalis* (Oxalidaceae), *Stellaria* (Caryophyllaceae), *Cirsium* (Compositae), *Aconitum* (Ranunculaceae) are often met. Coccinellidae are indicated on the edges and glades. 23 lady beetle species (63.9% of the total fauna) have been registered. The mass species are *Coccinella septempunctata* Linnaeus, 1758, *C. quinquepunctata* Linnaeus, 1758, *C. hieroglyphica* Linnaeus, 1758, *Exochomus quadripustulatus* (Linnaeus, 1758), *Hippodamia tredecimpunctata* (Linnaeus, 1758), *Psyllobora vigintiduopunctata* (Linnaeus, 1758), and *Coccinulla quatuordecimpustulata* (Linnaeus, 1758). The rare species are *Coccinella nivicola* Mulsant, 1850, *Halyzia sedecimguttata* (Linnaeus, 1758), *Scymnus nigrinus* Kugelann, 1794, and *S. frontalis* (Fabricius, 1787).

Dark coniferous forests are developed on well drained sites. The tree stratum is represented by *Abies*, *Picea obovate, Pinus sibirica (Pinaceae),* small-leaved species are sometimes occurred. In the shrub stratum, *Lonicera* (Caprifoliaceae), *Rosa* and *Sorbus* (Rosaceae) grow. The grass-bushwood stratum is dominated by *Vaccinium vitis-idaea, V. myrtillus* (Ericaceae), *Maianthemum* (Asparagaceae), *Equisetum* (Equisetaceae) etc. In the lower sites, thickets of *Salix* (Salicaceae), *Angelica* (Apiaceae), *Carex* (Cyperaceae), *Calla* (Araceae), *Typha* (Typhaceae) are recorded. Dark coniferous forests have clearings with a rich herbaceous variety. In the dark coniferous forests, 7 Coccinellidae species (19,44%) have been registered: *Harmonia axyridis* (Pallas, 1773), *H. quadripunctata* (Pontoppidan, 1763), *Oenopia conglobata* (Linnaeus, 1758), *Anatis ocellata* Linnaeus, 1758, *Halyzia sedecimguttata*, *Coccinella septempunctata*, and *C. nivicola*.

In the zonal ecosystem of north taiga of Western Siberia, we have studied the species diversity of Coccinellidae inhabiting the following biotopes: light-coniferous forests and pine-spruce-birch forests.

Light coniferous forests. The first stratum of light-coniferous forest is represented by *Pinus* (Pinaceae). *Betula* (Betulaceae) and *Populus tremula* (Salicaceae) constitute the second stratum. Light coniferous forests provide optimal conditions for regrowth of pines, birches and shrubs of *Sorbus* (Rosaceae). The grass cover is mosaic and poor. *Ledum, Vaccinium vitis-idaea, V. myrtillus* (Ericaceae), *Trientalis* (Primulaceae), *Maianthemum* (Asparagaceae), numerous Poaceae etc. grow in the studied biotope. The basis-ground vegetation is represented by moss-lichen communities. 10 Coccinellidae species (27,8%) were indicated in the studied biotope. The common species are *Coccinella septempunctata*, *C. nivicola*, *Coccinella quinquepunctata*, *Anatis ocellata*, *Harmonia axyridis*, *Hippodamia variegata* (Goeze, 1777), *Scymnus frontalis*, *Stethorus pusillus* (Herbst, 1797), *Hippodamia tredecimpunctata*, and *Exochomus quadripustulatus.*

Pine-spruce-birch forests*.* The tree stratum is represented by *Betula* (Betulaceae), *Populus tremula* (Salicaceae) and *Pinus* (Pinaceae). Among the shrubs, one can meet *Rosa*, *Rubus idaeus* (Rosaceae), among the bushwoods – *Vaccinium vitis-idaea, V. uliginosum, V. myrtillus* (Ericaceae), and *Rubus saxatilis* (Rosaceae). The grass cover constitutes 60–75%, it is dominated by grass-sedge-motley association. Among the flowering plants, we should note *Pulmonaria* (Boraginaceae), *Atragene*, *Thalictrum* (Ranunculaceae), *Geranium sylvaticum* (Geraniaceae), *Galium* (Rubiaceae), etc. There are many lichens and mosses in the forest. In the lower sites, there are thickets of ferns.

The Coccinellidae are associated with edges and glades where the grass vegetation is affected by aphids. Pine-spruce-birch forests are characterized by average humidification conditions. 19 lady beetle species (52,77%) have been indicated in this biotope.

The mass species are *Coccinella septempunctata*, *C. quinquepunctata*, *C. hieroglyphica*, *C. trifasciata* Linnaeus, 1758, *Hippodamia tredecimpunctata, Coccinulla quatuordecimpustulata*, and *Psyllobora vigintiduopunctata*.

The rare species are *Harmonia axyridis*, *Anatis ocellata*, *Halyzia sedecimguttata*, and *C. nivicola*.

To study the Coccinellidae species diversity and their association in the azonal ecosystems we have examined 6 biotopes: pine forest, birch-pine forest, flood meadows, willow stands, raised bogs, and fens.

Pine forest*.* The shrub stratum is represented by *Populus tremula* (Salicaceae), *Betula* (Betulaceae), *Sorbus* (Rosaceae), *Pinus sibirica* (Pinaceae). Thickets of *Rosa*, *Rubus idaeus* (Rosaceae) are observed. Variety of lichens is observed. Among the grass vegetation, *Trifolium* (Fabaceae), *Veronica* (Plantaginaceae), *Thalictrum* (Ranunculaceae), *Potentilla* (Rosaceae) have been found in the flowering stage. In this biotope, 9 species of Coccinellide (25.7%) are indicated: *Coccinella septempunctata*, *Propylaea quatuordecimpunctata* Linnaeus, 1758, *Adalia bipunctata* Linnaeus, 1758, *Anatis ocellata*, *Harmonia axyridis*, *Oenopia conglobata*, *Myzia oblongoguttata* Linnaeus, 1758, *Calvia quatuordecimguttata* (Linnaeus, 1758), and *Hippodamia notata* (Laicharting, 1781).

Pine-birch forest is characterized by well-expressed stratification. The first stratum (from 5 to 20 m and higher) includes *Pinus* (Pinaceae) and *Betula* (Betulaceae), the second stratum – *Populus tremula* (Salicaceae), *Sambucus (Adoxaceae)*, *Pinus sibirica* (Pinaceae), *Sorbus* (Rosaceae). In this biotope, thickets of *Rubus idaeus*, *Rosa* (Rosaceae), are found, among the bushwoods there are *Vaccinium vitis-idaea, myrtillus* (Ericaceae).

The grass covering constitutes 60–67%. Among the flowering plants we should note *Atragene*, *Thalictrum* (Ranunculaceae), *Sanguisorba officinalis* (Rosaceae) etc. The moss-lichen covering is locally developed. The lower sited are dominated by Calamagrostis-motley vegetation. 15 Coccinellidae species (41.7%) are found in this biotope. The mass species are *Coccinella septempunctata*, *C. quinquepunctata*, *C. trifasciata*, *Hippodamia tredecimpunctata*, *Calvia quatuordecimguttata*, *Oenopia conglobata*, and Propylaea quatuordecimpunctata. The rare species are *Adalia bipunctata*, *Coccinella nivicola*, *Anatis ocellata*, and *Stethorus pusillus*.

Flood meadows are well expressed in the river basins of the studied region and are characterized by dense herbage. The most typical association is grass vegetation (*Festuca valesiaca, Carex*). On the meadows, there are small thickets of *Salix* (Salicaceae) and single trees of *Pinus* (Pinaceae), *Sorbus* (Rosaceae), *Betula* (Betulaceae), *Populus tremula* (Salicaceae). Abundant herbs are represented by *Vicia cracca*, *Trifolium repens, T. pratense* (Fabaceae), *Myosotis* (Boraginaceae), *Aconitum* (Ranunculaceae), *Solidago virgaurea*, *Cirsium* (Compositae), *Angelica* (Apiaceae), *Potentilla anserina* (Rosaceae), *Chamerion angustifolium* (Onagraceae). In the flood meadows, 10 Coccinellidae species (27.8%) are found. The mass species are *Coccinella septempunctata*, *C. quinquepunctata*, *Hippodamia tredecimpunctata*, *Anisosticta novemdecimpunctata* Linnaeus, 1758), *A. sibirica* Bielawski, 1958, *Coccidula scutellata* (Herbst, 1783), and *C. rufa* (Herbst, 1783). The lady beetles *Myzia oblongoguttata*, *Calvia quatuordecimguttata*, *Propylaea quatuordecimpunctata* are rather rarely indicated.

Willow stands are characterized by silty, swampy ground. The territory is under water during long periods, so this biotope has a high humidity, favorable for reproduction of aphids – food for lady beetles. The grass cover is poor, represented by cereal-sedge communities. Only in the end of June – beginning of July, *Potentilla anserina* (Rosaceae), *Anemone, Ranunculus* (Ranunculaceae), *Veronica* (Plantaginaceae) start flowering.

We have registered 7 species of Coccinellidae (19.44%). The mass species are *Hippodamia tredecimpunctata*, *Coccinella septempunctata*, *Propylaea quatuordecimpunctata*, and *Psyllobora vigintiduopunctata*.

Raised bogs are characterized by an excessive level of insolation. The vegetation if this biotope has a rather poor biodiversity. *Betula* (Betulaceae), *Pinus* (Pinaceae), *Salix* (Salicaceae) are locally found. The grass cover is represented by *Andromeda, Ledum* (Ericaceae), *Comarum*, *Rubus chamaemorus* (Rosaceae), *Vaccinium* (Ericaceae). The moss layer is dominated by sphagnum.

In the raised bogs, 5 Coccinellidae species are found (13.88% of the fauna): *Coccidula rufa*, *C. scutellata*, *Anisosticta novemdecimpunctata*, *A. sibirica*, and *A. bitriangularis* Say, 1824.

Fens. Willow patches of *Sorbus* (Rosaceae), small thickets of *Rosa* (Rosaceae), *Lonicera* (Caprifoliaceae) and *Ribes* (Grossulariaceae) are observed. Locally, *Vaccinium vitis-idaea* (Ericaceae) is indicated. Among the grass vegetation, *Calamagrostis* (Poaceae), *Comarum*, *Rubus arcticus* (Rosaceae), *Aconitum* (Ranunculaceae), *Epilobium* (Onagraceae), *Carex* (Cyperaceae), *Equisetum* (Equisetaceae) etc. are found. Mosses are mostly represented by *Bryum* (Bryaceae), *Sphagnum* (Sphagnaceae) and *Hylocomium* (Hylocomiaceae).

We have found 8 species of lady beetles (16.66% on the total fauna). The mass species are *Hippodamia tredecimpunctata*, *Hippodamia variegata*, *Coccinella septempunctata*, and *Propylaea quatuordecimpunctata*.

In the anthropogenic and anthropogenically transformed natural ecosystems, the following groups of biotopes are indicated: clearings in the dark coniferous forest, road sides and waste lands.

Clearings in the dark coniferous forest are characterized by the abundant diversity of plants, among which there are single trees: *Abies*, *Picea obovata*, *Pinus, P. sibirica,* (Pinaceae), *Betula* (Betulaceae). The shrubs are dominated by *Rosa*, *Rubus idaeus* (Rosaceae) and *Lonicera* (Caprifoliaceae). In the lower sites, there are thickets of *Angelica* (Apiaceae), *Chamerion angustifolium* (Onagraceae), *Carex* (Cyperaceae), *Calla* (Araceae), *Typha* (Typhaceae) etc. On *Angelica* affected by aphids, we have found *Coccinella septempunctata*, *C. trifasciata*, *C. hieroglyphica*.

In the clearings of the dark coniferous forest, 9 species of lady beetles (25%) are found: *Exochomus quadripustulatus*, *Coccinella septempunctata*, *C. trifasciata*, *C. hieroglyphica*, *Coccinella quinquepunctata*, *C. magnifica*, Redtenbacher, 1843, *Oenopia conglobata*, *Propylaea quatuordecimpunctata*, and *A. sibirica*.

Road sides and waste lands. All these areas have low humidity, the following ruderal plants are found: *Taraxacum, Sonchus* (Compositae), *Plantago* (Plantaginaceae), *Leonurus* (Lamiaceae), etc. The flowering plants: *Potentilla anserina* (Rosaceae), *Melilotus*, *Vicia cracca, Trifolium repens* (Fabaceae), and *Chamerion angustifolium* (Onagraceae) are predominating. The soil structure is damaged and represented by man-made ground. Only 4 species (11.1% of the total fauna of Coccinellidae) are found in this biotope: *Coccinella septempunctata*, *C. quinquepunctata*, *Hippodamia variegata*, and *H. tredecimpunctata.*

Discussion

The biotopic diversity of lady beetles depends on a complex of biotic and abiotic factors where the most important are trophic connections, search ability and selectivity in nutrition. The analysis of biotopic association of Coccinellidae in the studied region has shown that the highest species diversity is registered in the mixed forest, especially in the edges and glades – 23 species (63.88 % of the total number of species); in the pine-spruce-birch forest – 19 species (52.77%); in the pine-birch forest – 15 species of Coccinellidae (41.66%); in two biotopes, light coniferous forest and flood meadow, we have registered 10 species in each. The least number of Coccinellidae species is found in the raised bogs (5 species), road sides and waste lands (4 species).

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