ALIEN SPECIES OF EARTHWORMS IN THE ECOSYSTEMS OF THE URALS

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The introduction of alien species is part of global natural changes and often results in significant losses of biological diversity and the importance of ecosystems prone to biological invasions. Of the approximately 3700 species of earthworms described, about 3 % are invaders in certain regions. The share of lumbricides (family Lumbricidae) accounts for about 30 species. Alien species of earthworms have appeared in the Urals recently. According to our data obtained as a result of genetic analysis of DNA using a "molecular clock", the age of introduction of *Aporrectodea caliginosa* is about 200 years (Shekhovtsov et al., 2016). According to T.S.Vsevolodova-Perel, in natural habitats of the Urals (until 1985), *Lumbricus rubellus* was absent, the distribution of *A. caliginosa* and *A. rosea* was limited, with rare exceptions, to synanthropic habitats and arable lands.

The aim of the research was to study the distribution of alien and native species of earthworms in the Urals.

The inventory counting of earthworm species from our own collections (from 2006 to 2020) was carried out using the Vsevolodova-Perels'key (1997) with the updating of the names in the international database. The data of the Identification guide "Earthworms of the Fauna of Russia: Cadaster and Key" by T.S Vsevolodova-Perel (1997) were taken as the initial species composition. To analyze the ratio of native and alien species of earthworms in natural habitats, in 2015 and 2020 various counts were carried out in the main types of natural habitats, in the Southern, Middle and Northern Urals, where the maximum diversity of endemic species of earthworms in the Urals had been previously noted. In the process of calculating the proportion of invasive species, the cosmopolitan species *D. octaedra* and *O. tyrtaeum* were not taken into account.

On the territory of the Urals, 18 species and three subspecies of earthworms were noted. Additionally, *Dd. rubidus subrubicundus*, *A. caliginosa trapezoides*, *A. longa*, *E. balatonica*, *E. sibirica*, *El. tetraedra hercynia*, *L. rubellus* were reported.

For the Southern Urals, 16 species and 1 subspecies have been identified. *A. trapezoides*, *L. rubellus* (ubiquitous)**,** *E. balatonica* were appeared. *A. caliginosa* was widespread. According to 2020 data, the habitats located in the subalpine belt and higher, as well as nemoral forests, had been least affected by invasions. No invasive species have been noted there. The endemic species of the Urals were dominant: *P. tuberosa*, *P. diplotetratheca*, *E. intermedia*, or *E. n. nordenskioldi* – above the subalpine belt.

In the aspen forests, even on the territory of the Zyuratkul National Park, the share of endemic species was 33 %, the share of invaders was 17 %. *L. rubellus*, *P. tuberosa*, and *E. intermedia* were dominate. 2 endemic and 1 invasive species have been reported.

All types of meadows are significantly captured by invasions. The share of endemic species was 25 % – *E. intermedia*, alien species – *L. rubellus* – 25 %. *L. rubellus* dominates.

The maximum proportion of invasive species was 75 % – has been noted in floodplain areas, both in forests and meadows. The share of endemic species iwas 25 %. Dominated by *A. c. caliginos*a and *L. rubellus*. *P. tuberosa* was noted among the endemic species.

Quantitative and qualitative surveys in 2020 did not show the *E uralensis* species, which are characteristic of the floodplains and meadows of the Southern Urals.

A. longa appears in the Urals (in synanthropic habitats); *P. tuberosa*, *O. tyrtaeum*, *A. rosea* (locally as a dominant), *E. fetida*, *E. balatonica*, *E. uralensis*, *El. t. tetratheca*, *L. rubellus* were found in the Middle Urals in mountain ecosystems in comparison with the data of the cadastre-guide of earthworms of Russia (1997). *L. terrestris*, *Dd. rubidus subrubicundus* were found in cities. *A. c. caliginosa* was reached wide distribution, including in natural habitats. Boggy sedge meadows lack alien and endemic species.

The share of invading earthworm species in forb- gramineous meadows was 17 %, endemic – 33 %. *L. rubellus* and *P. diplotetratheca* were dominant. The endemic ones were characterized by *P. diplotetratheca* and *P. tuberosa*.

Fir-spruce forests of different types were distinguished by a wide variety of lumbricid fauna (up to 8 species on one site). The share of endemics was 25 %, alien species – 37 %. *P. diplotetratheca* was dominant. The following species acted as subdominants: *A. c. caliginosa*, *L. rubellus*, *A. rosea*.

The floodplain habitats were characterized by the absence of endemic species and the dominance of *L. rubellus*. The share of alien species was 60 % (*A. c. caliginosa, L. rubellus, A. rosea*). 7 species of earthworms were found in the Northern Urals.

The following species have been reported for the first time: *E. atlavinyteae, L. rubellus, O. tyrtaeum, A. c. caliginosa*.

The Northern Urals were characterized by the absence of alien species of earthworms in most habitats. The percentage of endemic species is up to 0–50 %. *E. atlavinyteae, E. nordenskioldi*, and *P. diplothetrateca* were dominant.

Invasive species have been noted on the banks of water reservoirs. 100 % alien species were found in sedge meadows. *A. c. caliginosa* and *L. rubellus* were dominant. In forb and green moss pine forests, the percentage of alien species was 37 %, endemic – 17 %. *A. c. caliginosa* was dominant. *P. diplothetrateca* is common among endemic species.

For the Subpolar and Polar Urals in mountain habitats, 3 species of lumbricids have also been noted. In the floodplain of the Ob Bay, the habitat of *E. sibirica, E. balatonica, Dd. rubidus subrubicundus, O. tyrtaeum, El. t. hercynia* (dominant in coastal emissions).

As a result of the research, there has been noted a shift towards the north of the area of endemics of the Southern Urals: *P. tuberosa, E. uralensis*; endemic of the Southern and Middle Urals – *P. diplotetratheca* (distribution in mountain ecosystems further to mountain tundras). There has also been noted a spread of invasive species of European origin in natural biotopes, which has been increasing over time: *A. c. caliginosa, A. rosea, L. rubellus*.

References

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