The Impact of Alien Plant Species on Environmental Parameters Habitarits Slope Forest-Steppe

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Abstract. This research looks at the results of studying the role of invasive plant species in the transformation of habitats. Changes in the main environmental parameters are established tracts gullies oak and meadow-steppe tracts (soil moisture, climate humicity, soil richness, light-shading). Expands cenotic specificity of plant invasions in Middle Russian Upland conditions caused by heterogeneity of habitat landscape and its human evolution. Consequences of plant invasions identify cenotic and landscape ecological strategy of invasive species in the region, resulting in the replacement (dubbing) is not only at the species level, but also at the level of zonal types of communities.

1. Introduction
In the era transformed the environment natural degradation processes, synanthropization and depletion zonal vegetation, which covered almost all the continents and became one of the key problems of ecology. Active biological invasions of alien species in natural ecosystems are a serious threat to biodiversity \cite{1, 2} and cause significant economic damage to the regions \cite{3}. At present, the study of plant invasions goes beyond simply identifying and analyzing alien floras \cite{4, 5, 6}. The foundations invasive ecology, biology and biogeography, explores the possibilities for the use of invasive plant species as a resource, programs have been developed to control the behavior of invasive alien species \cite{7, 8}.

The task of the modern scientific research is the expansion of knowledge about human evolution geosystems highly developed areas. Since 2004, we conducted studies of biological invasions in the Middle Russian forest-steppe ecosystems, which aim at studying the role of alien species in the transformation of plant communities forest-steppe complex and the development of measures to improve the sustainability of natural plant communities in terms of cenotic press of invasive species. In this work, summarized and statistically processed materials that reveal the influence of alien plant species on ecological parameters of slope habitats of the forest-steppe.

The aim of this work is to study the influence of alien plant species on the ecological parameters of habitats of the slope forest-steppe. Research objectives: to identify the environmental parameters of the main ecotopes; to determine the direction of the process of transformation of habitats.

2. Equipment and devices used in studies
The objects of study were communities of oak forests and calciphytic (limestone and chalk) steppes, which compose the slope steppe within upland. In the north of the hill, the greatest landscape and ecological significance is played by devonian limestones with a thickness of about 300 m. Characterized by a dense network of valleys and ravines, high intensity of erosion processes. In the south and south-west hill critical landscape and ecological importance chalk and marl \cite{9}.

The geographical position of the region dictates the dominance of temperate continental climate. The average annual temperature is +5,5 ° C. The degree of continentality natural increases from north-west to south-east. The annual amount of precipitation decreases from 550 mm in the north-western part of up to 500 mm in the south-east and even 450 mm in the eastern part. North hills widespread gray steppe
soils and podzolized black soil in the center - leached black soil, in the south-typical black soil. The study area is characterized small plots of zonal vegetation. The degree of urbanization of region is estimated at 7.3% and belongs to the category of high [10]. The natural conditions of the Middle Russian upland represent a landscape-ecological background for the introduction and dispersal of alien plant species.

On the basis of processing 230 geobotanical descriptions of user sites 100 m² environmental rating scales in the program Cyganov_scale_new alg spent phytoindication evaluation of environmental parameters habitats [11, 12]. In the sample participated gebotanical descriptions (grouped by formations of vegetation) of native plant communities without alien component in the flora and replacement of plant communities with the active participation of invasive species within the same object of study. The result revealed phytoindication values for each vegetation community (in the rank of the association), calculated by the amplitude of the tolerance of the species composing the association. Numerical evaluation of the ecological parameters of the habitat was calculated by the mean values [8]. The following parameters were analyzed: climate thermal mode (TM), climate continentality (KN), climate aridity / humidity (OM), cryoclimatic (CR), soil moisture (HD), soil trophicity (TR), soil richness with nitrogen (NT), soil acidity (RC), light / shade (LC), humidification variability (FH). A change in these values determines the succession and genesis of cenoses (Lysenko, 2004) with the participation of transformer plants. The results obtained are statistically processed, the average values (X) for plant formations, the standard deviation (ơ), minima (min) and maxima (max) are calculated.

3. Results and Discussion

Invasive flora of the Middle Russian forest-steppe includes 26 species - "transformers" (34.2%). The introduction of invasive plants leads to a decline in the role of zonal dominant species and (or) co-dominants in natural plant communities; in some cases, they are completely replaced by alien biomorphs [13]. In plant communities of the Middle Russian forest-steppe of the most successful "transformers" are 11 species (14.5%): Arrhenatherum elatius, Acer negundo, Bidens frondosa, Impatiens parviflora, Echinocystis lobata, Lupinus polyphyllus, Robinia pseudoacacia, Fraxinus pennsylvanica, Sambucus racemosa, Viburnum lantana, Parthenocissus quinquefolia. Infestations of these species are accompanied by the development of allogetic succession, which are characterized by lower species diversity of communities.

Processes of plant invasions are natural for the region and are observed in communities of floodplain forests and meadows, indigenous and derived forests and sub-forests, broad-leaved and mixed forests, plain, slope meadow and calciphytic-petrophytic steppes. Plant invasions in forests of the region are characterized by expansion of 3 types of trees (Acer negundo, Fraxinus pennsylvanica, Robinia pseudoacacia) and 5 species of shrub (Sambucus racemosa, Caragana arborescens, Viburnum lantana, Amelanchier spicata, Parthenocissus quinquefolia) ergasiophytes. The introduction of biomorphological close taxa native species does not lead to a significant transformation of the environmental parameters of forest habitats (table 1, 2). In general, the amendments are aimed towards increasing moisture and richness of the soils of forest habitats.

| Table 1. Statistical indicators of environmental factors (EF) habitats gullies oak without an invasive component in flora |
|-----------------|--------|------|------|------|
| EF              | X      | ơ    | min  | max  |
| TM              | 8.5    | 0.10 | 8.3  | 8.7  |
| KN              | 8.5    | 0.07 | 8.3  | 8.7  |
| OM              | 7.9    | 0.19 | 7.8  | 8.1  |
| CR              | 7.9    | 0.07 | 7.8  | 8.1  |
| HD              | 11.8   | 0.11 | 11.6 | 12.0 |
| TR              | 6.7    | 0.13 | 6.6  | 7.0  |
| NT              | 5.6    | 0.15 | 5.4  | 6.0  |
| RC              | 7.5    | 0.19 | 7.2  | 8.0  |
| LC              | 4.4    | 0.14 | 4.0  | 4.6  |
| FH              | 5.8    | 0.30 | 5.5  | 6.0  |
Table 2. Statistical indicators of environmental factors (EF) habitats gullies oak with an invasive component in flora

| EF | X    | σ     | min | max |
|----|------|-------|-----|-----|
| TM | 8.6  | 0.29  | 8.4 | 9.2 |
| KN | 8.7  | 0.19  | 8.3 | 8.9 |
| OM | 7.9  | 0.14  | 7.8 | 8.2 |
| CR | 8.2  | 0.22  | 7.9 | 8.7 |
| HD | 12.2 | 0.42  | 11.5| 12.8|
| TR | 6.7  | 0.24  | 6.1 | 7.3 |
| NT | 5.9  | 0.29  | 5.3 | 6.4 |
| RC | 7.5  | 0.20  | 7.2 | 8.0 |
| LC | 4.2  | 0.13  | 4.0 | 4.7 |
| FH | 5.8  | 0.35  | 5.0 | 6.3 |

Slope meadow steppe on limestone is subject to deeper demutations-active overgrowth of rocks with woody vegetation. Back in the early XX century on the territory of the reserve "Galichya mountain" Lipetsk region slopes were occupied by grassy communities, and the rocks-relict flora. By the beginning of XXI century increased overgrowth of woody species of open slopes of reserve (7-11 sites), among which Acer negundo plays a major role [13]. Changing the ecology of Rocky habitats can lead to the extinction of populations of heat-loving light-loving calciphytic-petrophytic plants. Revealed that under the influence of trees and shrubs advent transformation environmental parameters slope habitats (table. 3, 4) occurs in the direction of increasing soil moisture (X from 9.4 to 12.3), climate humidity (X from 7.4 to 7.9), soil richness (X from 4.5 to 6.1), illumination-shading (X from 2.7 to 4.1); decrease in climate continentality (X from 9.3 to 8.7), soil acidity (X 8.7 to 7.5) and soil temperature (X 8.7 to 8.2).

Table 3. Statistical indicators of environmental factors (EF) habitats slope steppes on the limestone without an invasive component in flora

| EF | X    | σ     | min | max |
|----|------|-------|-----|-----|
| TM | 8.7  | 0.08  | 8.6 | 8.9 |
| KN | 9.3  | 0.12  | 9.1 | 9.5 |
| OM | 7.4  | 0.11  | 7.2 | 7.6 |
| CR | 7.7  | 0.12  | 7.5 | 7.9 |
| HD | 9.4  | 0.11  | 9.2 | 9.6 |
| TR | 7.7  | 0.11  | 7.5 | 7.9 |
| NT | 4.5  | 0.11  | 4.3 | 4.7 |
| RC | 8.7  | 0.07  | 8.6 | 8.8 |
| LC | 2.7  | 0.09  | 2.5 | 2.8 |
| FH | 6.7  | 0.11  | 6.5 | 6.9 |

Table 4. Statistical indicators of environmental factors (EF) habitats slope steppes on limestone with an invasive component in flora

| EF | X    | σ     | min | max |
|----|------|-------|-----|-----|
| TM | 8.4  | 0.06  | 8.3 | 8.5 |
| KN | 8.7  | 0.12  | 8.5 | 8.9 |
| OM | 7.9  | 0.10  | 7.7 | 8.0 |
| CR | 7.6  | 0.08  | 7.5 | 7.8 |
| HD | 12.3 | 0.15  | 12.0| 12.6|
| TR | 6.4  | 0.21  | 6.1 | 6.8 |
| NT | 6.1  | 0.15  | 5.9 | 6.4 |
| RC | 7.5  | 0.15  | 7.3 | 7.8 |
| LC | 4.1  | 0.12  | 3.9 | 4.4 |
| FH | 6.6  | 0.10  | 6.4 | 6.8 |

Even in highly transformed xerophilic tracts of cretaceous outcrops in the South of the forest-steppe with a high proportion of synanthropic plants, we have not observed alien dominants analogous to calciphytic "natives". In such conditions, usually one or two (rarely three) alien species have stable
positions in the addition of azonal communities. In the southern and south-western parts of the Middle Russian forest-steppe Elaeagnus angustifolia and Robinia psuedoacacia have great success in the development of cretaceous outcrops. Accompanying cretaceous complexes erosional landforms (flow hollows, ravines) are actively inhabited by Fraxinus pennsylvanica, Acer negundo and Lonicera tatarica. These species began their expansion from the watershed protective forest plantations.

When occlusion of the chalk slopes of the woody vegetation change environmental factors occurs in the direction of increasing by the following characteristics (table. 5, 6): termokhimicheskoi (X from 9.0 to 9.2), continental climate (X 9.7 to 8.0), salt regime of soils (X 6.9 to 7.2), soil moisture (X from 9.1 to 9.5), richness of soil nitrogen (X from 4.2 to 4.5) and light-shading (X 2.2 to 2.4). Almost equal to the values observed for creolisation (X ranging from 8.0 to 8.1), without changes in the variability of moisture (X 6.5 to 6.5) and aridity-guienot (X from 7.4 to 7.4). Significantly decrease soil acidity (X 8.7 to 7.5).

Table 5. Statistical indicators of environmental factors (EF) habitats slope steppe on the chalk without an invasive component in flora

| EF   | X    | σ    | min | max |
|------|------|------|-----|-----|
| TM   | 9.0  | 0.08 | 8.8 | 9.1 |
| KN   | 9.7  | 0.07 | 9.6 | 9.8 |
| OM   | 7.4  | 0.12 | 7.2 | 7.6 |
| CR   | 8.0  | 0.08 | 7.8 | 8.1 |
| HD   | 9.1  | 0.12 | 8.9 | 9.3 |
| TR   | 6.9  | 0.15 | 6.5 | 7.1 |
| NT   | 4.2  | 0.12 | 4.0 | 4.5 |
| RC   | 8.7  | 0.07 | 8.6 | 8.8 |
| LC   | 2.2  | 0.07 | 2.1 | 2.3 |
| FH   | 6.5  | 0.08 | 6.4 | 6.6 |

Table 6. Statistical indicators of environmental factors (EF) habitats slope steppe on the chalk with an invasive component in flora

| EF   | X    | σ    | min | max |
|------|------|------|-----|-----|
| TM   | 9.2  | 0.07 | 9.1 | 9.3 |
| KN   | 9.8  | 0.08 | 9.7 | 9.9 |
| OM   | 7.4  | 0.07 | 7.3 | 7.6 |
| CR   | 8.1  | 0.07 | 8.0 | 8.3 |
| HD   | 9.5  | 0.07 | 9.4 | 9.6 |
| TR   | 7.2  | 0.11 | 7.0 | 7.4 |
| NT   | 4.5  | 0.11 | 4.3 | 4.7 |
| RC   | 8.6  | 0.09 | 8.5 | 8.8 |
| LC   | 2.4  | 0.07 | 2.3 | 2.6 |
| FH   | 6.5  | 0.08 | 6.4 | 6.7 |

4. Conclusion
Implementation of ecological-coenotic strategies of invasive species in natural communities is accompanied by restructuring the ecology of the habitats. In terms of slope forest this is reflected in significant changes in the environmental parameters of the habitat. It is established that first of all such ecological parameters as soil moisture, climate humus, soil richness, light and shade change. A similar transformation is the result of anthropogenic evolution of ecosystems, which are accompanied by fundamental changes in forest-steppe vegetation: oak forests develop on the mechanism of substitution of native Quercus robur dominated by alien tree species; in ecotone habitats observed replacement of zonal communities with Acer tataricum with cenoses with Acer negundo; slope meadow step on limestone loses its relict features under the influence of tree and shrub vegetation dominated by Acer negundo.

Studies of the role of alien species in the transformation of ecological habitats of native ecosystem is the basis for the monitoring zone, typical azonic, intrazonal natural systems. The results obtained in the slope habitats of forest-steppe are logged in the database in the environment Ecxel and form the
environmental framework for the regulation of the system of measures for the rational use of plant resources in the region.

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