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SAMARA UNIVERSITY

# Introduced species in new ecosystems: concerning possible distortions of local biogeochemical cycles

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# We are glad to greet You, dear colleagues!



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Some problems of introduced plant species effects on ecosystem processes were investigated in different countries abroad but were not discussed yet for Middle Povolzhye (forest-steppe and steppe communities hardly influenced by anthropogenic factor)



## Chapter 1 Non-native Species, Ecosystem Services, and Human Well-Being

Montserrat Vilà and Philip E. Hulme

### 1.2.1 Impacts on Supporting Services

Supporting services are the basis for nutrient and energy flows. There are three main components that contribute to these flows, including primary productivity, nutrient and water cycling, and habitat structure. Biological invasions can impact each of these components within the supporting services, as illustrated in a seminal study by Vitousek and Walker (1989) showing the dramatic impact a non-native plant can have on N soil cycling. Some plants have mutualistic N<sub>2</sub>-fixing microorganisms; thus, the N obtained through this mechanism first accumulates in the plant tissue, but rapidly cycles within the ecosystem and then accumulates in the soil. Major changes can occur in the fertility of the soil when a N<sub>2</sub>-fixing species is introduced in a poor soil. Vitousek and Walker (1989) demonstrated that the introduction of the Macaronesian actinorhizal N<sub>2</sub>-fixing shrub, *Morella faya*, into Hawaii by Portuguese settlers in the late 1800s, increased soil N by one order of magnitude after it soon spread to young lava flows and open-canopy forests. The lack of native N<sub>2</sub>-fixers in these early-succession ecosystems enhanced N mineralization, thereby contributing to the increasing soil N. Since this pioneering work, there have been dozens of studies showing changes in N cycling after invasion (Castro-Diez and Alonso 2017). Many of these changes are irreversible and change the habitat conditions for both plant and animal native species.

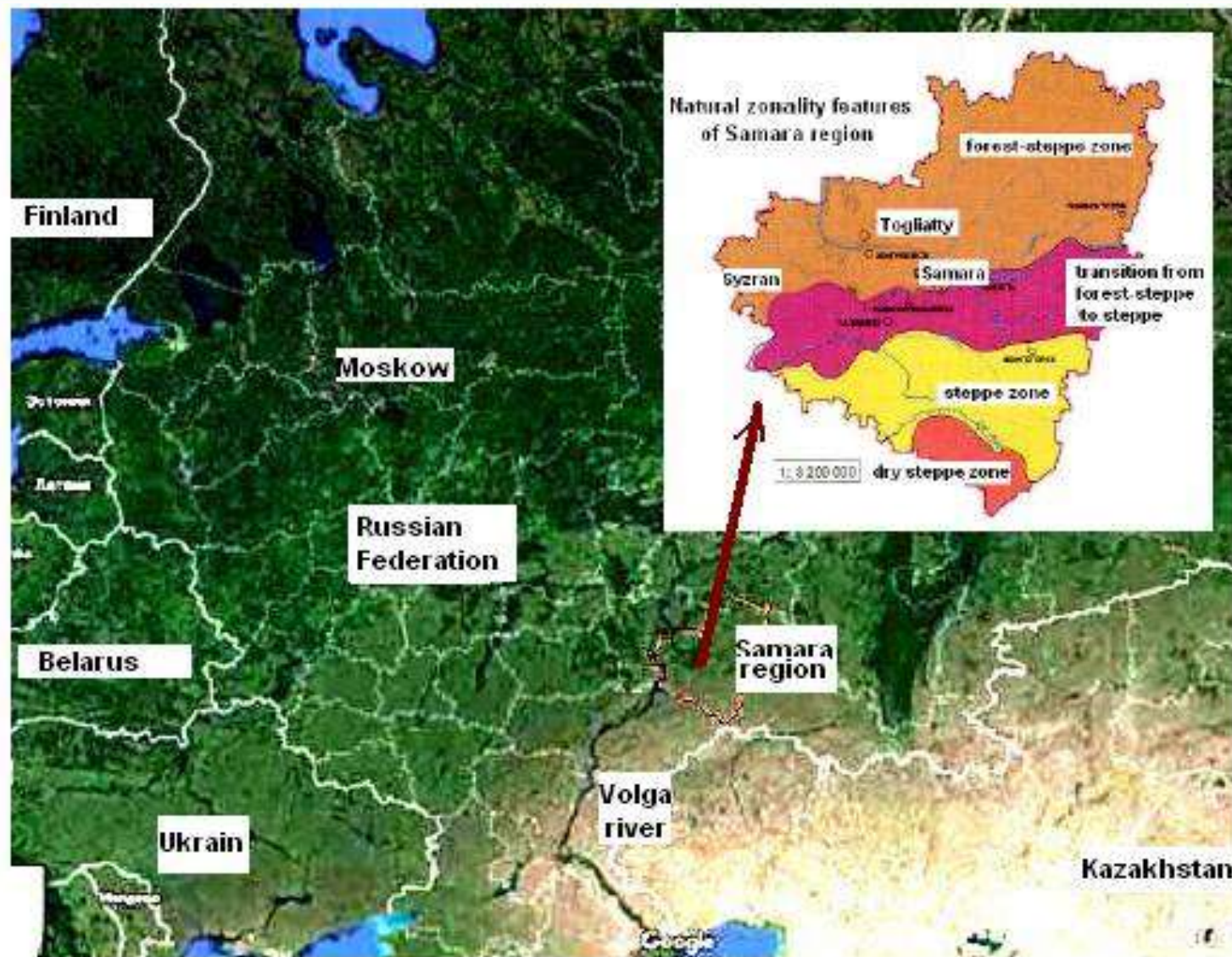
Invading Nature - Springer Series in Invasion Ecology  
ISBN 978-3-319-45119-0 ISBN 978-3-319-45121-3 (eBook)  
DOI 10.1007/978-3-319-45121-3

Library of Congress Control Number: 2017931686

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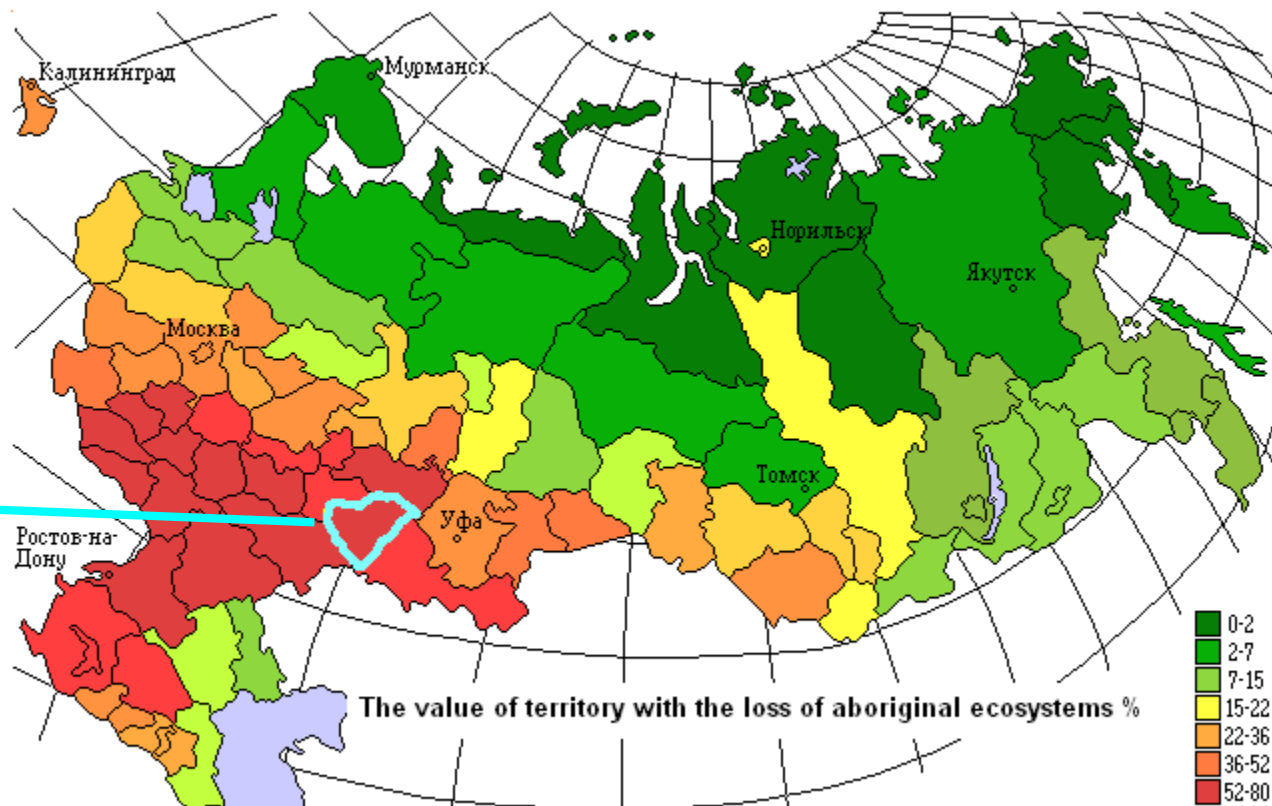
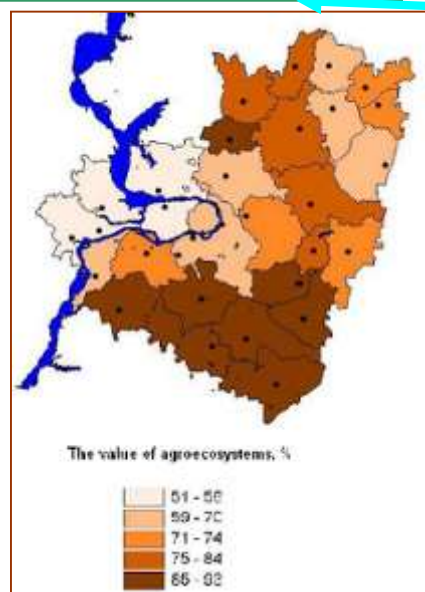
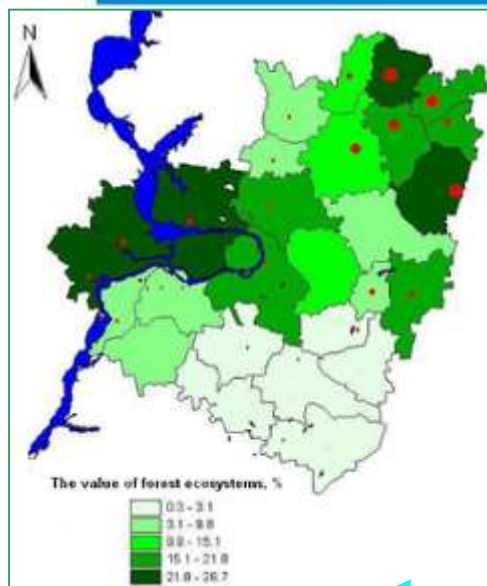
## Features of Samara region geographical position and zonation







# The state of nature ecosystems transformation in Samara region





## The mix of fields and steppes...







## Some kinds of our nature ecosystems





## Introduced trees and their possible action directions

The higher plants species during introduction demonstrate their properties, sometimes going beyond their traits in the natural areas. The most striking example may be given in this case is *Acer nugundo* L. (ash-leaved maple from the North America, a common component of forests in river valleys). In the forest-steppe –steppe landscapes of the Middle Volga region, it became a tree weed that exhibits exceptional resistance to abiotic stress conditions, including droughts.

Being introduced to alien territories, **tree species can generate different sorts of “distortions” into local biogeochemical cycles** in natural ecosystems and anthropogenically transformed environment. We would like to list briefly some kinds of such influence expressed in the conditions of the forest-steppe and steppe ecosystems of our region.







## Some possible ways of introduced trees directions...

The direct or indirect **effects on water cycle** may be connected with:

- the changes in water balance due to additional transpiration during the overgrowth of previously treeless localities with the transition from grassy to pseudo-forest communities (*Ulmus foliaceae* L., *Acer negundo* L., *Elaeagnus angustifolia* L.).
- the emission of additional amount of terpenes and other aeroions into the air (various types of coniferous and deciduous trees and shrubs), which can act as centers of water vapor condensation.





## The transition from grassy to pseudo-forest communities (*Ulmus foliaceae* L. and *Acer negundo* L. invasion)







- The procedure of field aeroions evaluation into the air (various types of coniferous and deciduous trees and shrubs). The aeroions can act as additional centers of water vapor condensation



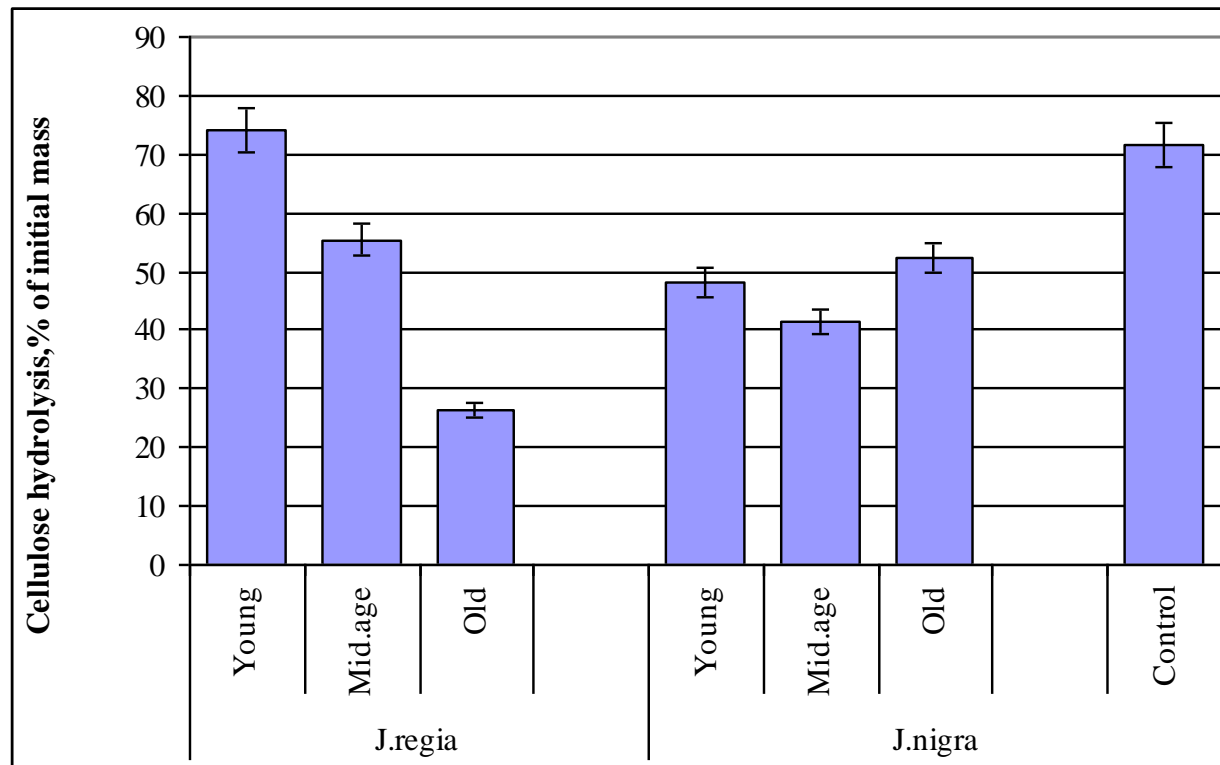
## Some possible ways of introduced trees directions...

The direct or indirect **effects on carbon cycle** (as well as nitrogen and phosphorus) may be connected with:

- the formation of leaf mass not eaten by local phytophages, replenishing the fund of leaf litter (*Acer negundo* L., *Aesculus hyppocastanum* L., species of *Juglans* genera.).
- the influence on the soil biological activity by stimulating or inhibiting the development of soil microbiota members (different tree species including *Juglans cinerea* L., *J. mandshurica* Maxim. , *J.nigra* L. and others).
- the **changes in the soil nitrogen balance**, especially pronounced for species with "symbiotic support" (*Elaeagnus angustifolia* L., *Hyppophae ramnoides* L.).







Some facts of trees influence on the soil biological activity:  
soil cellulases activity changes in the subcrone environment  
of Juglans tree species (application procedure was used).





## *Elaeagnus angustifolia* L. invasions on the former fields and pastures







The above effects were detected by us for the few species including named above using various field and laboratory methods. Now we can consider them at the level of their identification as such

Their scale assessment at the ecosystem level may become a next stage.

An analysis of the possibilities of identifying new pseudo-forest communities developing on the grassy deposits was carried out in local conditions by integrating ground-based survey data and remote sensing.

This aspect seems to be valuable for our region with highly mosaic combination of natural, cultivated, anthropogenically transformed and other territories.





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**THANK YOU**

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