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The assessment of the efficiency of environmental activities in Moscow

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ABSTRACT

Environmental issues in the Russian Federation have attracted the attention of researchers, although they rarely become the subject of quantitative analysis. Unfortunately, environmental protection in Russian towns (that has a history of its own and deserves attention) is dropping off the radar. Moscow can be a convenient object for quantitative analysis, where full-fledged natural communities and biological diversity have still been preserved in the conditions of the last 25 years of the construction boom. The purpose of my work is to understand what contributes to this. 89 implemented/not implemented projects of economic activity in Moscow were selected for the object of this research. If this environmentally harmful activity is prevented, we can speak of the success in environmental work (that was considered as a dependent variable). The predictors were the vigorous activity of urban environmental agencies and the public, the legal status of the territory, the type of vegetation cover, the habitats of rare species of plants and animals, and the nature of the planned economic activity. The analysis was carried out using Generalized Linear Models. The results showed the importance of active environmental protection, while environmental statuses cannot prevent economic development. The capabilities of officials exceed the capabilities of the public. The likelihood of the civil society actively opposing the harmful activities is increased by two variables, the forest and the habitats of rare species, while we failed to establish factors that significantly affect the activities of officials.

Key words: *Wildlife conservation in megacities, Nature protected areas, Civil society,*

Introduction

The complicated history of the environmental movement in Russia and the challenges that environmentalists have faced at different times are reflected in the specialist literature (Oldfield, 2002; Oldfield and Shaw, 2002; Gladun and Zakharova, 2017), but these studies are hardly concerned with the cities and towns of Russia, including Moscow, the largest of them. Meanwhile, the problems of preserving biological diversity in cities have long become global and have evolved into an independent scientific field (Dearbon and Kark, 2010), in which Moscow is practically not mentioned (Werner and Zahner, 2008). But the environmental activities in the largest urban metropolitan area in Europe clearly deserve attention. The issues of nature conservation in Moscow have been covered in several little-known publications in Russian (Zakharov, 2019), however, all these works are descriptive and don't include a quantitative analysis.

In general, environmental research in Russia normally comes down to listing problems and alterations in the environmental policy at different stages of the country's history (Henry and Duhovnikoff, 2008; Oldfield and Shaw, 2002;

Gladun and Zakharova, 2017; Newell and Henry, 2017). Quantitative assessments are much less common and are associated with economic indicators (Tokunaga, 2010) or space imagery analysis. In the latter case, changes in forested areas in Specially Protected Natural Reservations (SPNR) of different categories and in adjacent territories are studied (Wendland *et al.,* 2015) and hence the effectiveness of this conservation strategy. In this regard, Moscow, where economic activity is much more transparent to the public, favorably compares with remote regions and may become the subject of a more detailed empirical study to include the assessment and comparison of various environmental instruments. The investigation of the potential of each environmental instrument to prevent the implementation of environmentally harmful economic development projects is the object of my research.

The objective of the study is to compare the effectiveness of various methods of nature conservation applied in Moscow.

Reviews on the Russian environmental practice highlight a number of methods (Larin *et al*., 2003; Henry and Duhovikoff, 2008; Newell and Henry, 2017) that can be grouped into several groups:

- Creating Specially Protected Natural Reservations (SPNRs) of various categories;
- Creating state environmental agencies;
- Law making;
- The work of nature conservation enthusiasts and non-governmental organizations.

All these methods are also relevant for the Russian capital.

Materials and Methods

On the whole, passive methods (legal statuses) and active practices of environmental protection work can be identified. The legal mechanisms for the protection of nature in urban areas include:

- The status of SPNR;
- A natural complex in the structure of urban land;
- The status of the water protection zone;
- A monument of landscape art;
- Habitats of plant and animal species from the Red Book of Moscow.

There are two means of active nature conservation: the work of state environmental organizations and the social movement of Muscovites in defense of wildlife.

Studies focused on environmental assessment typically consider SPNRs located at a distance from cities and include variables such as natural resources, vegetation cover, poaching activity, topography, soils, distance to highways, and other factors not relevant to a metropolis (Hocking, 2003; Wendland *et al.,* 2015). While natural reserves are usually allocated in territories that are hardly suitable for economic use (Wendland *et al*, 2015), the entire territory in Moscow has substantial material value and is of interest to developers. The city is also characterized by specific forms of anthropogenic transformation (primarily urban landscaping that is annually increasing in scale in Moscow).

The effectiveness of each environmental instrument was assessed by examining their potential for preventing the implementation of urban development and other economic activities affecting natural or green areas. Projects of various economic activities were used as objects of research that were associated with obvious negative environmental consequences (n=89).

These are the construction of housing (n=21), non-residential capital facilities (12), road construction (16), placement of sports facilities (12), park landscaping (32), and their combinations. Urban land improvement involves the creation of recreational parks with natural vegetation being replaced by lawns. Each project could be implemented (n=72) or not implemented (17). In the latter case, we could speak of the success of environmental activities. Each project could cause or failed to cause counteraction by environmentalists, but they always affected areas with environmental statuses. Information about the projects was kindly provided to the author by a public environmental organization – Moscow City Society for the Protection of Nature. Economic activity in the natural territories of Moscow is certainly much more vigorous, however, the analysis only includes projects known for some environmental protection work associated with them or its absence. The analysis covers the period from the year 2000 to 2016; it was by 2000 that the modern nature conservation system in Moscow and the existing network of SPNRs had finally been formed.

The analysis also considered the nature of the vegetation in the projected territories. All the variety of plant cover in Moscow is reduced to the following main types:

- Forests of various composition with internal fringes and glades (n=41);

- Herb meadows (55);
- Water verge vegetation (44);
- Artificial vegetation (fruit gardens and green plantings of park type) (20).

One project may cover areas with different types of vegetation cover.

As a result, each project had a set of 17 parameters assigned (legal status, environmental protection activities, types of violation, types of vegetation cover) that were considered as predictors of a dependent variable: the success or failure of conservation activities, i.e. opportunities to prevent environmentally harmful economic activities. All variables, both dependent and independent ones, have a binomial distribution. The obtained materials are summarized in the table that shows projects of economic activities in the lines and their qualitative characteristics and the effectiveness of environmental protection activity in the columns.

The subsequent analysis of the data was carried out in several stages. At the first stage, the number of predictors was reduced, as the predictors that correlated with each other were deleted. Since the obtained data contains many repeating values, a nonparametric tetrachoric correlation coefficient was selected. One of the two predictors was deleted if there was a correlation between them (tetrachoric correlatione ”0.65, $p<0.05$). Correlation analysis was performed in the Statistica 6.0 Program. At the next stage of the analysis, the logistic regression method was used to predict outcomes of environmental protection work and environmental protection activities. The data was processed in R environment: GLM-models were used (function “GLM”, family=binomial, link = “logit”). After statistically insignificant predictors were removed, the models were compared using the ANOVA test (the chi-square version) (function “anova”, test = “Chisq”). Akaike Information Criterion (AIC) was also used when comparing models; models with various variables were selected using the “stepAIC” function (MASS package). The step-by-step selection involved a combined method (stepwise stepwise). Excessive variance was detected using the pchisq function ($p<0.05$).

The forecast quality in the models obtained was estimated using a confusion matrix with a threshold t=0.5 and ROC curves (Receiver Operator Characteristics) (ROCRpred and ROCRperf functions. the ROCR package). The “predict” function was used with artificial data sets in order to estimate the probability.

The minimal sample size (n=78) was obtained with subsequent dates: $\alpha = 0.05$; $\beta=0.05$; P=0.4; P0=0.6, power =0.95).

Results

As a result of the correlation analysis, three variables were deleted. In addition, the variable “nature_komplex” was removed from the list of predictors as all the studied territories have this status.

The use of the GLM function demonstrated the decisive importance of active environmental protection of public activists and officials (Table 1). Other predictors removed don’t affect the outcome as shown by the chi-square test (p=0.29). The use of the pchisq function showed the absence of excess dispersion (p=0.98). Public engagement increases the likelihood of a positive outcome from 0.01 to 0.24; and from 0.01 to 0.57 in urban conservation agencies.

Since the crucial importance of active environmental work has been revealed, it is interesting to learn what predictors affect it. In order to find the answer, the “society” and “officials” parameters were considered as dependent variables. Three predictors were reliably established for the “society” variable, forest vegetation, rare species from the Moscow Red Book, and road construction (Table 2). Forest vegetation increases the likelihood of social activity from 0.1 to 0.38; rare species of plants and animals – from 0.1 to 0.29; the value of the “roads” variable is not significant. No excess variance was found for this model (p=0.29).

The model (including all the predictors) reliably showed the value of the “buildings” variable for the

Table 1. Statistically significant coefficients for the “result” predictor.

Coefficients	Estimate Std.	Error	z value	Pr(>|z|)
(Intercept)	-4.305	1.047	-4.111	3.94e-05 ***
society	3.153	1.107	2.848	0.00440 **
officials	4.588	1.225	3.745	0.00018 ***

dependent variable "officials". However, in a model including this predictor only, the value of the chi-square criterion turned out to be significant (p=0.01); therefore, the reduced model is less consistent with the data. Regression across all subsets revealed several variables, two of which turned out to be statistically significant: "buildings" and "society" (Table 4). The ANOVA test didn't reveal differences from the original model including all predictors (p=0.05); there was no excess dispersion for this model (p=0.35). The "buildings" variable increases the likelihood of a response from 0.04 to 0.20, and the "society" variable – from 0.04 to 0.15. In general, the quality of the forecast in the model is low.

The variables "forest" and "buildings" included as predictors of the dependent variable "result" demonstrated the influence of only the first of them. A comparison of two models (with one including active conservation work, and the other including the "forest" variable) showed lower values of AIC and residual deviance (p=0.01). In order to express the quality of the assessment an error matrix and ROC curves were constructed for each of the two models. The quality of the model additionally including the "forest" variable was higher (Table 5). The model that included the interaction between these three predictors, did not reveal reliable regression coefficients.

Table 5. A comparison of the assessment quality of models that only include active environmental work as a predictor (Model 1) and additionally the "forest" variable as a predictor (Model 2).

	Model 1	Model 2
Sensitivity	0.65	0.82
Specificity	0.97	0.94

Sensitivity, the percentage of correctly predicted positive outcomes;
Specificity, the percentage of correctly predicted negative outcomes.

Discussion

So, we can say that the wildlife in Moscow has been preserved due to the active nature protection activity. Consequently, the legal mechanisms, including the SPNR status, and environmental laws cannot be regarded as a sort of guarantee that protects natural territory from environmentally harmful economic activities, although some researchers consider the creation of a network of SPNRs in Moscow a major achievement (Zakharov, 2019).

The low efficacy of the status of special protection is generally typical for the SPNR of Russia (Wendland *et al*., 2015). However, solely legal protection cannot prevent the urbanization of natural areas in other cities of the world (Breuste, 2004). A

Table 2. Statistically significant coefficients for the "society" predictor.

Coefficients	Estimate Std.	Error	z value	Pr(>|z|)
(Intercept)	-2.1510	0.6231	-3.452	0.000557 ***
Forest	1.6976	0.5270	3.221	0.001277 **
Red_book	1.3012	0.6017	2.162	0.030586 *
Roads	-2.0942	0.8570	-2.444	0.014542 *

Table 3. Statistically significant coefficients for the "officials" predictor.

Coefficients	Estimate Std.	Error	z value	Pr(>|z|)
(Intercept)	-3.1825	0.6232	-5.106	3.28e-07 ***
Buildings	1.8505	0.6734	2.748	0.0060 **
Society	1.4821	0.6888	2.152	0.0314 *

Table 4. Statistically significant coefficients for the "result" predictor (includes the predictor "forest")

Coefficients	Estimate Std.	Error	z value	Pr(>|z|)
(Intercept)	-3.819	1.034	-3.691	0.000223 ***
Forest	-2.822	1.209	-2.335	0.019558 *
Society	3.961	1.174	3.374	0.000740 ***
Officials	6.316	1.660	3.804	0.000142 ***

study conducted in the SPNR of other countries showed that the effectiveness of nature protection is influenced by the intensity ratio of the pressure of traders and the environmental efforts of the government (Nolte *et al.*, 2013).

Therefore, the active efforts of environmental organizations and enthusiasts can only prevent environmentally harmful activities. But it is more difficult to understand what affects environmental activity.

The results of the analysis showed two predictors that attracted the citizens' attention to environmental protection: forest vegetation and rare species of plants and animals, with the former having a greater influence. I shall note that the attitude to nature among residents is rather versatile, and it varies depending on education, cultural levels, age, social status and other factors (Zakharov, 2018). All of these variables were not included in the analysis. In addition, Russians generally believe that environmental protection is the domain of specialists rather than the general public (Tikhomirova, 2005). Nevertheless, the results demonstrate that the forest and rare species attract the attention of Muscovites and increase the likelihood of social activity more than other predictors. The sympathy for the forest can be explained by established cultural traditions (Fraser and Kenney, 2000), whereas towns people tend to show indifference or even antipathy to many other valuable natural habitats, for example, ravines and swamps (Duhme and Pauleit, 1992).

It is more difficult to understand what motivates officials whose capabilities in environmental protection happened to be higher than those of ordinary citizens. The key importance of state agencies in the field of environmental protection is also shown for Russia as a whole (Gladun and Zakharova, 2017). Environmental statuses do not affect the actions of officials. The results obtained empirically confirmed the well-known thesis about the gap between laws and activities of Russian state environmental organizations (Newell and Henry, 2017), with environmental agencies occupying subordinate positions in the state hierarchy and working under pressure from business structures, constant bureaucratic reorganization, corruption, etc. (Henry and Douhovnikoff, 2008). We can conclude that the activities of state agencies are not transparent and are governed not by legislation but by some internal reasons hidden from society. The low quality of the models predicting the environmental activity of citizens and officials indicates the influence of other factors not included in the analysis that would be worth a separate study.

Conclusion

The results of the analysis of environmental activities in Moscow generally confirm the specifics of nature protection in Russia noted by other researchers. Economic activity is limited not by laws, but rather by internal motives that affect the officials. It is the officials who have a critical role among all the predictors included in the analysis. Along with the activities of state agencies, efforts by the public can prevent environmentally harmful activities, but they are less effective. The likelihood of social activity increases if the projected activity affects the forest and the habitats of rare species.

So despite the existing environmental status, the economic development of natural areas and sites in Moscow can be prevented only by active conservation activities.

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