



THE PROJECT OF ECOLOGICAL FRAMEWORK ELEMENT CREATION IN PRIVOLZHSKIY DISTRICT OF KAZAN CITY

Maria Alexandrovna Koshman* and Nafisa Mansurovna Mingazova

Kazan Federal University, Kazan, 18 Kremlyovskaya street, Kazan 420008, Russia Federation.

Abstract

The article discusses the structure of the ecological framework (EF) of Kazan, analyzes the areas of specially protected natural areas (SPNAs) as the key elements of the ecological framework. At the moment, the state of the ecological framework (city-forming element) of Kazan is assessed as unfavorable, there is no integrity of EF structure. The modern city of Kazan consists of seven administrative districts, with the total area of 42563 ha. There are 7 protected areas in the city of Kazan with the total territory of 3820.3 ha, which makes 8.97% of the city area. The ecological framework of the city corresponds to a mixed type of planning structure: linear and radial. Using the example of the Volga region, they consider the possibility of city EF element creation. The Volga region is located in the southern part of Kazan, it is an industrial center, which covers the area of 11577 hectares. When they analyzed this region, the following methods were proposed to combine EF elements into a single network: the creation of ecological wedges, the formation of new ecological nodes, the increase of water protection and green zones in SPNAs. During territorial planning and the development of master plans for territories, the ecological framework and all its aspects should be developed in detail. To preserve significant units of the natural environment, all the features of natural landscapes should be included in the framework structure.

Key words : Ecological framework, framework structure, framework wedges, ecological corridors, framework core, framework units.

Introduction

The main goal is to create favorable conditions for population activity in the process of city planning development. When they develop urban plans for the near future, all aspects of the ecological framework (EF) should be developed in detail.

The ecological framework is understood as a continuous system of ecologically interconnected natural territories, characterized by two signs: the ability to maintain ecological balance in the region; security by environmental protection measures, corresponding to the loads on nature (Gusev, 2003).

The structure of the frame includes all the features of natural landscapes, which allows you to save significant units of the environment (Titova, 2014).

The state of the ecological framework (EF) of most modern cities of the Russian Federation is unsatisfactory. With the growth of cities, natural landscapes are massively built up with residential areas, with an extensive transport

network. At the moment, the state of EF (city-forming element) in Kazan (the Russian Federation) is assessed as unfavorable (Nikitin *et al.*, 2010).

Materials and Methods

The article used the methodological approaches applied to territorial planning. They used the theoretical approaches by V.V. Vladimirov on the development of the ecological framework structure (Vladimirov, 1996). They used the cartographic materials of Kazan and the materials of the General Plan of Kazan, relevant for 2018 (the schemes of the natural-recreational framework, urban planning regulations, zoning, etc.). They processed the materials related to urban natural territory environmental protection, its planning and improvement. Space imagery was worked out using Google Earth programs. According to them, they determined the areas and the actual boundaries of SPNA.

The results were used to develop an ecological framework, taking into account the proper planning, design and management of the urban environment.

***Author for correspondence** : E-mail : masholga@yandex.ru

Results and Discussion

Ecological framework analysis of Kazan Spna as key elements

Currently, Kazan has seven administrative regions in its structure: Kirovsky - 10,879 hectares, Moscow - 3881 hectares, Sovetsky - 7687 hectares, Volga - 11577 hectares, Vakhitovsky - 2582 hectares, Aviastroitelny - 3891 hectares, Novo-Savinovsky - 2066 hectares. The total area of the districts is 42563 ha (Fig. 1, Table 2).

The analysis of the EF structure of the Kazan city (by the presence of green areas and water bodies) revealed the lack of integrity and continuity of possible framework elements (Fig. 2). Forests are scattered and divided by urbanized territory. Most of the forests have been preserved in the west of the city and it is a specially protected natural area of municipal significance “Lebyazhye Forest Park” at the moment, with the area of 3211 hectares. The smaller forests are preserved in the northeast and southeast of the city. There are also no links between them due to the presence of villages, roads and agricultural landscapes.

According to the State register data of SPNAs in the Republic of Tatarstan, Kazan, there are 7 protected areas: the City forest park “Lebyazhye” (the SPNAs of

local importance) located in several areas: Kirovsky district - 3211 hectares, Moscow - 185 hectares, Sovetsky - 198 hectares, Volga - 90 hectares, the total area is 3684 hectares; Kazan Arboretum, located in the Vakhitovsky district, the total area of which makes 1.2 hectares; Cedar Park, located in the Volga region, with the total area of 1 ha; The quarry ravine, located in the Soviet district, the total area of which is 5 hectares; the forest area “Russian-German Switzerland”, Dubki forest area and the Kazanka river. These territories are the ecological nuclei of the city. The largest are the Lebyazhye, Russian-German Switzerland and Dubki (State register of specially protected natural territories in the Republic of Tatarstan, 2007). There are no buffer zones separating these zones from residential areas and highways, thus the territories of SPNAs experience anthropogenic stress, which affects their ecological state. Separate elements of EF pass through

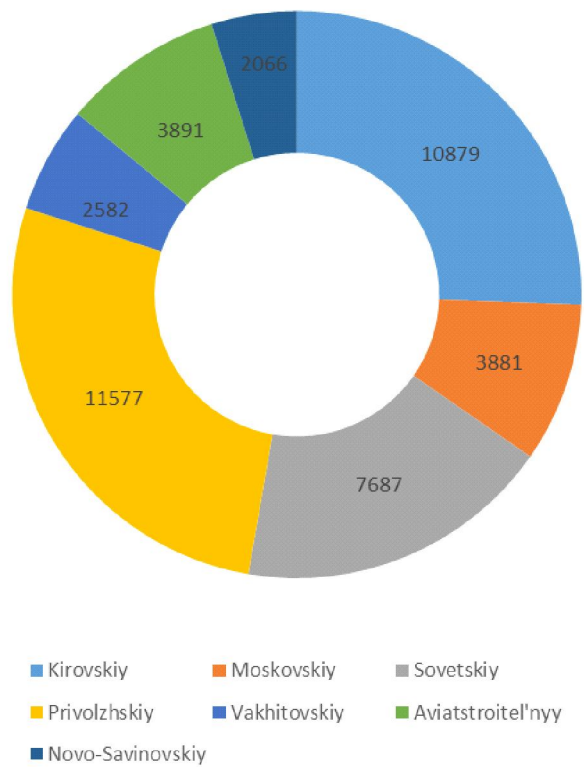


Fig. 1: The analysis of the areas of Kazan by administrative regions, ha.

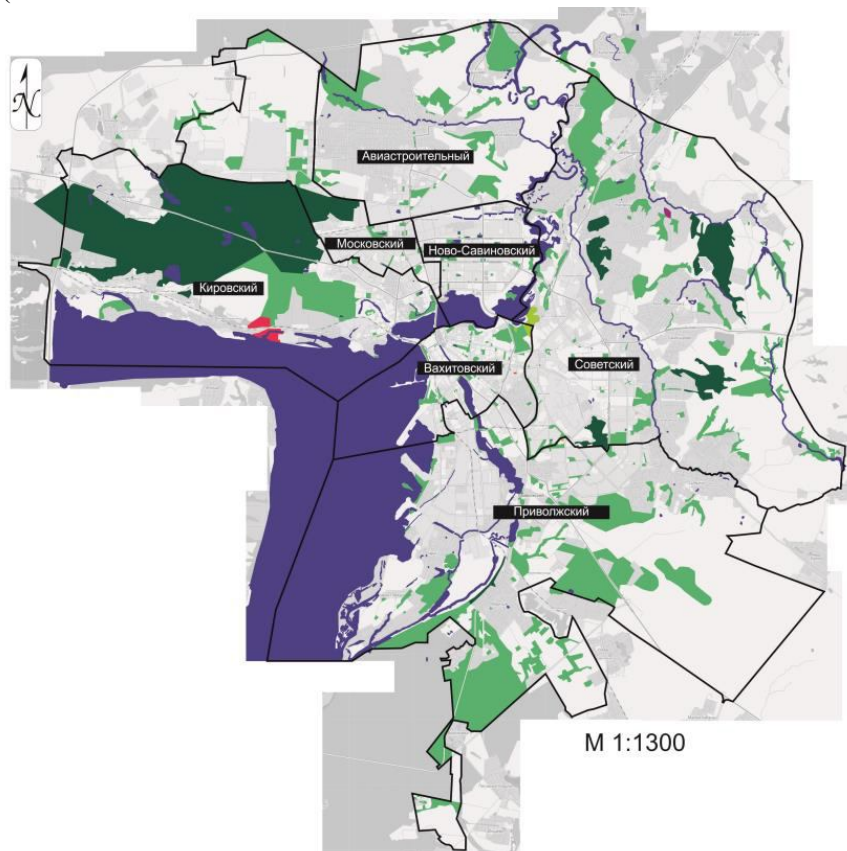


Fig. 2: Green zones and water bodies in the structure of the administrative districts of Kazan, significant for the development of the ecological framework.

Table 1: Analysis of ecological nucleus areas (SPNA) in the structure of the districts of Kazan.

No.	The name of the ecological core	Description of destination	Area by districts (ha)							Total
			Kirovskiy	Moskovskiy	Sovetskiy	Privolzhskiy	Vakhitovskiy	Aviastrotel'nyy	Novo-Savinovskiy	
1.	City Forest Park «Lebyagie»	pecially protected natural areas of local significance	3211	185	198	90				3684
2.	Kazan Arboretum	natural monument of regional importance					1,2			1,2
3.	Kedrovyy park	natural monument of regional importance				1				1
4.	Careerskii ravine	natural monument of regional importance			5					5
5.	Forest "Russian-German Switzerland"	natural monument of regional importance			15		15			30
6.	Array Dubky	natural monument of regional importance	25							25
7.	Pobedy Park	pecially protected natural areas of local significance							49,6	49,6
8.	Gorkogo Park	pecially protected natural areas of local significance					24,5			24,5
9.	Kazanka river	natural monument of regional importance		+	+		+	+	+	
10.	Total		3236	185	228	91	40,7		49,6	3820,3
11.	Area by districts (ha)		10879	3881	7687	11577	2582	3891	2066	42563
12.	Specially protected natural areas of local significance from the area of the district, %		29,7	4,7	2,9	0,8	1,57		2,4	8,97

the city, can be represented in the form of three wedges in a radial structure: the northern (Kazanka river), the western (Lebyazhye forest park) and the eastern (Kaban-Poduvallye lakes). The main and largest ecological corridor is the Kazanka River, which divides the city into two parts (Fig. 1, Table 1). The Kazanka River can actually be considered as an ecological wedge or the core of the EF; in this case, the elements of the linear structure of the EF take place. Thus, the ecological framework of the modern city corresponds to a mixed type of planning structure of the city: linear and radial (Elizarov, 2008).

The water bodies of the city of Kazan, as the elements of the EPC, are represented by the Kuibyshev Reservoir, the Kazanka River, its tributaries, lakes and lake-swamp complexes. The river flows through the Moscow, Soviet, Vakhitovskiy, Aviastrotel'nyy and Novo-Savinovskiy districts. The part of the channel is a natural monument of regional importance. Most water bodies belong to small shallow lakes of floodplain and suffosion origin (Mingazova & Malygina, 2017).

When they analyze the green framework of the city of Kazan, a small number of green zones were identified

in Novo-Savinovskiy and Vakhitovskiy districts. In the Soviet district, most of the green areas are located on the outskirts of the city and are absent inside the microdistricts. There are no specially protected natural areas in the Aviastrotel'nyy district. In the Volga region, the protected areas make only 0.8% of the territory. They include part of the SPNAs "Lebyazhye Forest Park" and "Cedar Park", with the total area of 91 hectares.

The analysis of the ecological framework of the Volga region

The Volga administrative region is located in the southern part of Kazan, it is an industrial center, and covers the area of 11,577 hectares. A large number of factory territories are concentrated in the district, and the city treatment facilities are located there. The greening coefficient in the center of the Volga region takes the lowest value, most of the green areas are on the outskirts. In the northeast of the territory, forests are scattered by anthropogenic landscapes, and there are no ecological corridors. The old valley of the river Volga (Mirny settlement - the Lake Poduvallye) is currently overgrown

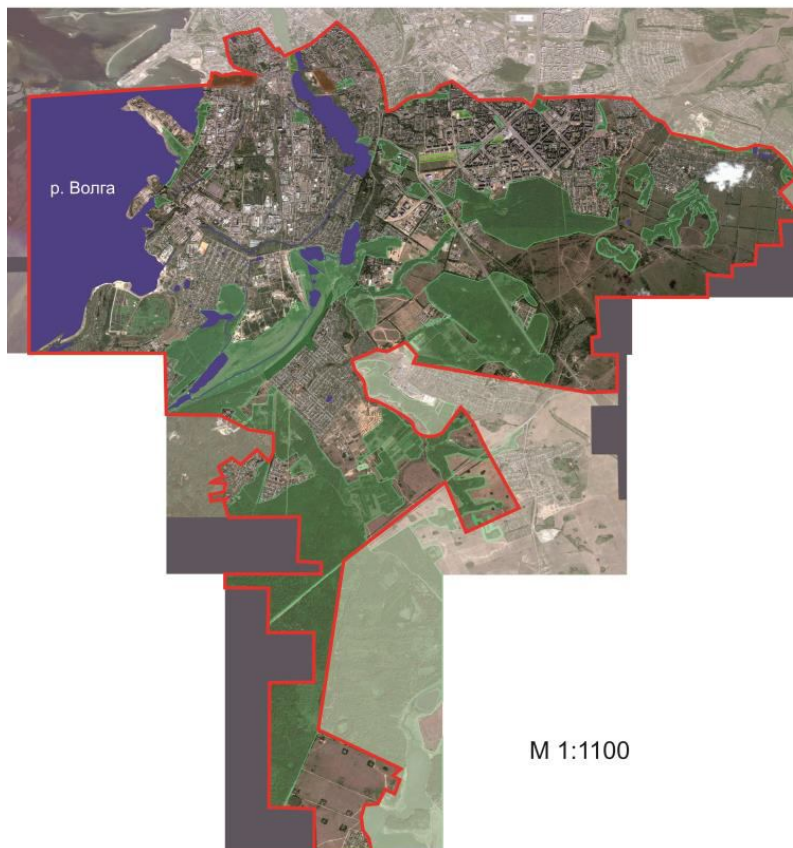


Fig. 3: Green zones and water bodies in the structure of the Volga region of Kazan, significant for the development of the ecological framework (by space imagery).

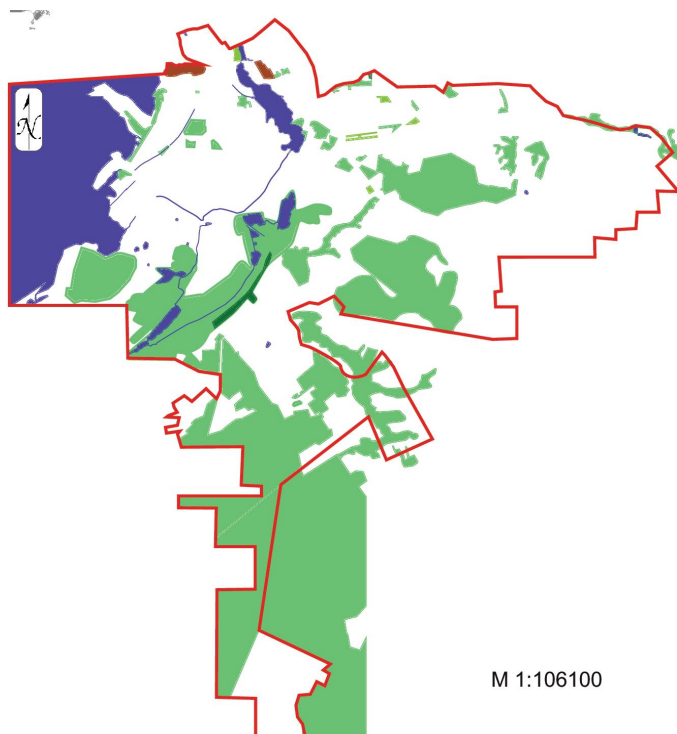


Fig. 4: The scheme of green zones and water bodies in the structure of the Volga region of Kazan, significant for the development of the ecological framework.

with meadow, wetland and tree-shrub vegetation. The forest massif is wedged from the southern part of the region, but it is divided from the northeastern part and does not have forest tracts that could be EF elements (Fig. 3.4).

The analysis of the Volga region showed that the territory has a small number of landscaped areas, thus the region has a low recreational potential. Industrial enterprises lack sanitary protection and buffer zones. The residential area is dense. There is a severe load on the existing elements of the ecological framework and on the state of the environment as a whole. The current state of the district does not meet environmental standards and requirements (Mingazova *et al.*, 2014).

2 ecological nodes - SPNA were identified on the territory of the district: the part of the Lebyazhye urban forest park (90 ha) and Cedar Park (1 ha). The part of the urban forest park “Lebyazhye” in the district performs the functions of a buffer zone and

an ecological corridor, animals can freely move around the area. The main ecological wedge of the EF is the system of Kaban lakes, namely the Verhniy and Sredniy Kaban lakes. The river Volga flows are located in the western part. There are no ecological corridors in the southern and eastern parts. Buffer zones are fragmented and separated in the northwestern and western parts (Fig. 3.4).

Recommended structure of the ecological framework of the Volga Region

During the analysis of the Volga administrative region, the following methods were proposed for combining EC elements into a single network: the creation of ecological wedges, the formation of new ecological nodes, the increase of water protection and green zones in protected areas (Vladimirov *et al.*, 1986).

In the EF structure proposed by the authors, the offered to consider forests in the north-eastern part of the Volga region as an ecological (green) corridor. The array, located from north to south, should be considered as an ecological wedge (Fig. 5).

The water bodies of this territory include the Kaban lake system, the tributaries of the river Volga, and small lakes. If possible, it is recommended to move

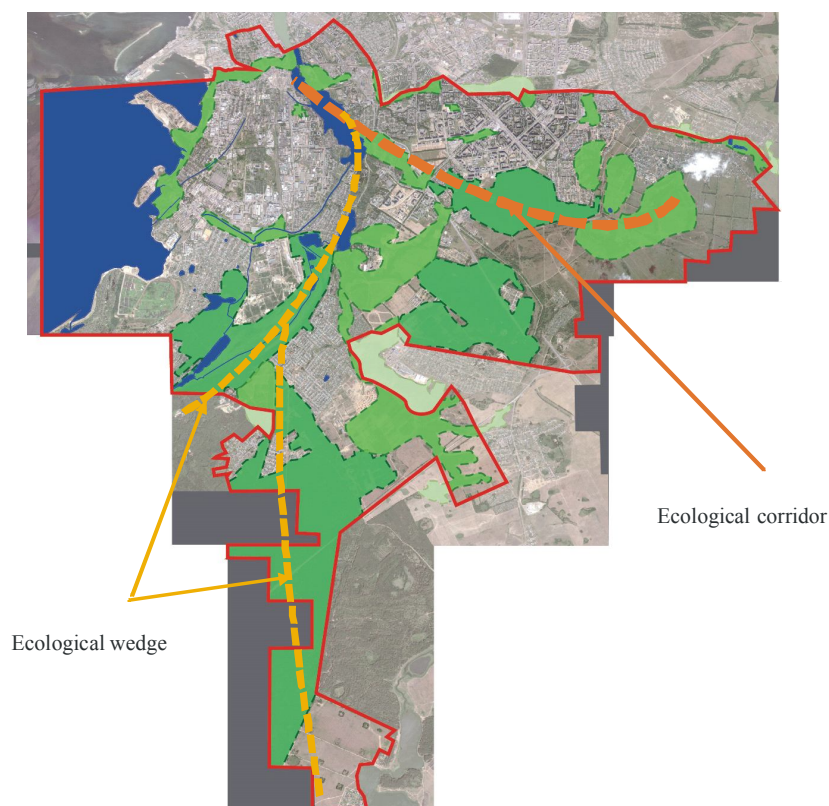


Fig. 5: Recommended EF structure of the Volga Region.

the boundaries of housing estates from water protection zones of water bodies with a further reduction of anthropogenic impact on these territories.

They designed environmental wedges that play a protective role in the EF. Due to constant anthropogenic interference with the environment, ecological wedges and corridors are negatively affected, but it is EF wedges that protect them from exposure. The wedges include green areas connecting the forests in the southern part, as well as southeastern and eastern ones. It is proposed to create sanitary protection zones near the Novo-Tatar and Arkhangelsk cemeteries in the form of additional landscaping and the displacement of residential buildings from the borders of cemetery territories.

They revealed the territories with high recreational potential: the lake Sredny and Verhniy Kaban, the tributaries of the river Volga, small lakes in the districts of Otar, Mirny and Salmachi. If necessary, ecological rehabilitation of water bodies should be carried out to improve their condition, each square and boulevard should be designed, taking into account the characteristics of each object, a clear zoning should be made between the recreational zone for people and the quiet zone for living animals, and a safe migration path through corridors and wedges should be provided (Fig. 5) The problem with the safe movement of animals through highways will be

solved by the construction of animal passages - wildlife crossings, which are the part of ecological corridor structure (Koshman *et al.*, 2019).

Conclusions

1. The analysis of the EF structure in Kazan revealed the lack of integrity and continuity for EF elements. Forests, once a single element, are scattered and divided by urbanized territory.
2. A small number of green areas were identified in Novo-Savinovsky and Vakhitovsky districts, SPNA make 2.4% and 1.57%, respectively. In the Sovetsky district, most of the green areas are located on the outskirts of the city and are absent inside the microdistricts, SPNA make 2.9%. SPNA are absent in the Aviastroitelny district.
3. SPNA make only 0.8% in the Volga region. It includes the part of the

protected areas “Lebyazhye Forest Park” and “Cedar Park”, with the total area of 91 hectares.

4. In order to create a full-fledged EF of the Volga administrative region, it is necessary to apply the methods of combining the elements of EF in a single network. They include the creation of ecological wedges, the formation of new ecological nodes, the increase of water protection and green zones in SPNAs.

Summary

Combining the preserved natural territories into the structure of the ecological framework of the Volga region, it is necessary to design in detail the squares and boulevards with the functions of the ecological framework elements. It is necessary to carry out a clear zoning between the recreational area for local residents and the quiet areas for living animals, providing a safe path for migrating animals through corridors and wedges in the buffer zones adjacent to the city. If necessary, they must carry out eco-rehabilitation of water bodies with their subsequent improvement, using environmental measures and materials. With the strict implementation of the tasks in compliance with environmental improvement methods, it is possible to achieve visible results - to improve the greening coefficient by raising it to 40% for the city, and

to improve the standard of people living in urban areas, reducing the anthropogenic pressure on the environment.

Acknowledgements

The work is performed according to the Russian Government Program of Competitive Growth of Kazan Federal University.

References

- Elizarov, A.V. (2008). Ecological framework - the strategy of steppe nature management of the XXIst century. *Samara Luke*, **17**, **2(24)**: 289-317.
- Gusev, A.V. (2003). The principles of regional network organization for specially protected natural territories (SPNT). *Bulletin of Voronezh State University: the series of Geography and Geoecology*, **2**: 92-99.
- Koshman, M.A., Z.G. Tukmanova and A.R. Safina (2019). The analysis of the scheme of action on water protection zone restrictions of the city of Kazan as the factor in the formation of the structure of the ecological framework. Ecological collection 7: Proceedings of young scientists. All-Russian youth scientific conference (with international participation) / Tolyatti: IEVB RAS, "Anna", 250-253.
- Mingazova, N.M. and M.A. Malygina (2017). Problem aspects of creation of Ecological park around the small lake city (an example of Lake Chara, Kazan, Russia). 4 th International Multidisciplinary Scientific Conference on Social Sciences and Arts. *Urban Planning, Architecture and Design: conference proceedings*, **2**: 685-691.
- Mingazova, N.M., A.V. Nikitin, G.A. Yupina and O.Y. Derevenskaya (2014). Strategy of management of city development with using «green» technologies (Kazan City, Russia). *Mediterranean Journal of Social Sciences*, **5(18)**: 341-343
- Nikitin, A.V., N.M. Mingazova and G.A. Yupina (2010). The problems of ecological-natural framework development in urbanized territories (using the example of Kazan). *The news of KazGASU*, 88-96.
- State register of specially protected natural territories in the Republic of Tatarstan. (2007). Ministry of Ecology and Natural Resources of the Republic of Tatarstan, Academy of Sciences of the Republic of Tatarstan. 2nd ed. Kazan: Idel-Press, 2007.406 p.
- Titova, O.V. (2014). The assessment of specially protected natural territories as the part of a regional ecological and cultural framework: dis. from the PhD in geography. *Moscow*, 192 p.
- Vladimirov, V. V. (1996). Settlement and ecology. – M.
- Vladimirov, V.V., E.M. Mikulina and Z.N. Yargin (1986). City and landscape. M.: Thought, 238 p.