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COVID-19 Pandemic –Milestone in Rediscovering the Rural Life

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ABSTRACT

This study investigates the positive aspects of the impact COVID-19 pandemic has had on rural development, providing several examples from the post-Soviet space. It is predicted that the intensification of dacha recreation phenomenon, which has been significantly influenced by the pandemic, will spatially extend beyond the periurban areas of the largest cities and will create the preconditions for the restoration of abandoned villages, development of rural tourism and preservation of "*archaic*" living techniques and traditional lifestyle. In an interdisciplinary context, we learn about the increased tendency of city dwellers to own second homes (dacha) in the countryside. Attention is drawn to the relationship between the COVID-19 pandemic and a decrease in solar activity, along with the decrease in the disinfection capacity of solar UV radiation. The curative proprieties of landscapes are investigated, methods of their valorisation are proposed, and landscape therapy is proposed to be considered during pandemics, some of the most effective activities being open-air walks, with inhalation of negative oxygen ions, phytoncides, terpenes. The growth of uncertainties due to unlimited and uncontrolled human society development is postulated. It is proved that development must consider the unpredicted effects of a catastrophe and use this knowledge to prevent other more devastating events and effects. In this context, the preservation of the primary, although outdated, living techniques is proposed, since they can act as important survival factors in critical mode. It is concluded that COVID-19 pandemic should be perceived as a milestone in the reorientation of geography and ecology towards understanding and advocating for nature preservation to be able to sustain human society in a continuous transformation.

1. PANDEMIC DEURBANIZATION

The aim of this work is to highlight new opportunities for rural development that are opening in relation to the emerging trends of pandemic deurbanization. Hence, the importance of dacha recreation, rural tourism, landscape therapy and the preservation of archaic lifestyle is increasing. This study proves that in Russian conditions, they can serve not only as important factors of survival, but they can also act as drivers of rural development. It is of great importance that most of the Russian citizens have country houses (dachas). Their role is illustrated in the works of A. I. Treivish, T. G. Nefedova, U. G. Nikolaeva, A. V. Rusanov. The present work reinforces this importance of landscape therapy techniques, which are especially significant in reducing the extreme level of ultraviolet radiation with which we associate the pandemic.

The pandemic has shown that living in a multi-story apartment building in high-density areas has become not only inconvenient, but also risky. Forced

isolation for social distancing purposes has led to the opposite - the physical compression of low-income families in cramped Khrushchev apartments and communal apartments. The high population density in cities makes them vulnerable to almost any natural and man-made disasters.

Several proposals for the settlement of residents of megalopolises in medium and small cities with polycentric development of urbanized territories were made (Kochurov and Ivashkina, 2020). Petrikov (2020) found several factors of deurbanization, as follows:

- the fatigue of the population in large cities from the deterioration of environmental conditions, traffic jams and other unfavourable factors of urban life;

- the growth of the values of the rural lifestyle in the public consciousness (closeness to nature, less stressful rhythm of life, the possibility of living in a manor house, etc.);

- changing consumer preferences in nutrition in favour of high-quality (including organic) products, and decreased demand in fast food;

- the desire to change the behaviour standards formed by mass culture, and the craving for the values of traditional culture and local cultural heritage;

- the formation of material and technical conditions for deurbanization: development of transport, communications, digital technologies, creation of high-performance machinery and equipment used by small work collectives.

The main factor of any disease is represented by high population density and overcrowding. It can be expected that northern metropoles are more susceptible to such infections, since a person spends most of his time in confined spaces such as offices, ground and underground transportation, supermarkets and at home. A strange situation is created: staying in a crowded office for a year, a man of the northern megalopolis rushes to rest on an equally crowded resort coast or in an equally crowded tourist centre. Meanwhile, viruses have been proven to have the ability to survive for a long time on sandy beaches, where increased moisture and a decrease in disinfecting ultraviolet radiation are generated. They are especially active during storm runoffs that wash away any type of waste onto the beaches (Zielinski and Botero, 2020).

Moving thousands of kilometres from their homes, tourists are forced to get used to the new natural environment, and to adapt again, upon returning to their usual place of residence. They should improve their health just by walking in a sparsely populated or even deserted, ecologically clean environment, perhaps in a familiar landscape-geochemical zone. Therefore, the coronavirus pandemic enhances the importance of dacha recreation, secluded landscape and therapeutic walks, local history, and rural tourism.

In the post-Soviet space, many townspeople own second homes (dacha) in rural areas. In the Moscow region, there are some 11.7 thousand garden and dacha villages in total. This is almost twice the number of rural settlements (Brade et al., 2013; Makhrova, 2014). There are approximately 2 million people living in garden and summer cottages (Arakelyan, 2020).

Russians own 17–20 million houses only in garden and dacha associations of second suburban estates (Treivish, 2014), that is, 120–140 buildings per 1000 inhabitants. At least 10 million more own a house in the village (Arakelyan, 2020), which means another 70 buildings per 1000 inhabitants. Treivish (2014) also emphasizes that these figures are twice the number recorded in any other country. For instance, there are only 13 summer cottages for every 1000 inhabitants in the United States (Treyvish, 2014). The prevalence of second country houses is estimated at an average of 70–90 buildings per 1000 people in the European countries (Nikolaeva and Rusanov, 2020).

There was a massive outflow of citizens to their dachas as the pandemic spread. Several million people (at least 5-6) left the two Russian capitals during March and April 2020 (Nikolaeva and Rusanov, 2020). This was facilitated by the transfer of school education to distance learning on March 21, 2020. Prices for suburban areas have increased in some regions by almost a third. In the Moscow region, they increased mostly in the western, most forested areas. Land price went up by at least 16% along Volokolamskoye, Rublevo-Uspenskoye and Novorizhskoye highways (Gusev and Minenkova, 2020).

The rural landscape of the Moscow region now belongs not only and even not so much to the rural residents; the townspeople have established here, as well. Some 2.75 million families (or about 5 million people) own land in the Moscow region, in total. Of these, about half of the land is owned by one million Moscow families (or about 2.5 million people) (Ioffe and Nefedova, 2001). But even among the landowners near Moscow, obviously, at least half of them are residents of the cities near Moscow and even of the cities from other regions of the country. Their country houses are becoming more and more residential all year round.

For Russia, the geopolitical significance of the pandemic deurbanization lies precisely in the possibility of restoring the abandoned villages. So far, this process is the most evident in the Moscow region, where summer residents significantly support the local population. They need local manpower to repair and equip their houses and care for plots, they buy natural food products (mushrooms, berries, fish, milk) from the local community. All of these stimulate new types of employment in villages and increases the retention of the population in the rural areas(Nefedova and

Medvedev, 2020). This trend is strengthening against the backdrop of the pandemic.

2. INTENSIFICATION OF RURAL RECREATION AND TOURISM IN RELATION TO THE PANDEMIC

Over the past 20 years, scientists and politicians have begun to pay more and more attention to the idea of multifunctionality of agriculture. Dacha management of natural resources in the post-Soviet space serves as a ready-made model of such multifunctionality. Dachas are used here from the rehabilitation to the cultivation of agricultural products (Treivish, 2014; Nefedova and Nikolaeva, 2019); a sanitary and epidemiological function has been added to them once with the coronavirus pandemic.

Dacha management of natural resources in Russia fits well with the concept of post-productivism, which positions rural areas as places of consumption with cultural and social amenities. It is important for a pandemic that the concept focuses on the multiple functions of rural landscapes rather than the multifunctionality of agriculture itself (Barnaud and Couix, 2020).

For instance, dacha management of natural resources through rural tourism combines two most contrasting spheres: agriculture, as the oldest and most basic foundation of the global economy, with tourism and recreation, one of the newest and fastest growing economic sectors.

In Russia, rural tourism is highly developed, but in a latent form. Statistically, Russian tourists prefer to rest in foreign resorts. The share of rural tourism in Russia is estimated at 2% (Okhotina, 2018). In fact, most of the Russian population visits Russian forests, at least for self-harvesting non-timber forest products; hence, if we also include visiting dachas as part of rural tourism, then this type of tourism will become massive. It serves all segments of population, although it is unorganized and spontaneous. Once with the virusophobia, secluded rural tourism outweighs even more the international tourism.

It is the same in many other developed countries. In the UK, for example, the number of travellers on weekends and vacations (the holiday tourism sector) is three times the number of people travelling outside the country (Williams, 2009). This is not counting people travelling for their own personal or professional purposes (visiting relatives, business trips, business), who sometimes have an implicit travel element in their trips. We can say that, on average, every inhabitant of the planet is in a state of traveller for some time in a year.

If ecotourism only allows taking photographs from nature, then rural tourism can also be accompanied by the procurement of mushrooms, berries, nuts, medicinal plants, and somewhere hunting and fishing. In this field, rest and recreation merge with food self-supply. Part of rural tourism is agritourism, associated with visiting farms and agricultural enterprises (cheese dairy, apiaries). The current reality is that more and more people have to purchase healthy products not from the stores, but directly from the locals in the countryside that prove to be reliable producers.

Many of Europe's farms would not be sustainable without the tourism component. On the other hand, they would not be viable as tourist sites without continuing to engage in agriculture (Badenkov, 2017).

In Russia, the state has shown little interest in supporting rural tourism. It develops spontaneously. Over the last third of the century, the process of reducing the active socio-economic space of Russia has been growing. Rural development is concentrated near the main cities along the "point", "pole" path (Zyryanov, 2018). The rural population of the non-Black Earth Region has decreased by 3-5 times (Averkieva, 2013). Some 26.8 thousand settlements have disappeared from the geographical map (Smirnova and Tkachenko, 2019). It is obvious that every year, one or two other thousand villages are added to this number. The depopulation of rural areas in Russia has become rampant and, according to Gunya and Efimov (2018) has led to the formation "*the new "Siberia" in the heart of Russia, where villages are abandoned, fields are deserted, overgrown with forest, and skeletons of churches that survived in the Soviet era stand alone*" (Gunya and Efimov, 2018, p. 20). As Rodoman (2017) notes, decadent, depressive areas are paradoxically located not so much on the geographic outskirts of Russia as everywhere within it, in the so-called the Russian province. The ubiquity of this "hinterland" gives hope for a new revival of rural areas in the post-pandemic conditions and the expected development of rural tourism.

3. DESTABILIZATION OF THE DISINFECTING PROPERTIES OF THE BIOSPHERE

Signs of a disease that can be identified as influenza in the literature appeared in the 16th century. Chizhevsky (1976) counted 45 global influenza epidemics from the 16th to the beginning of the 20th century. He also found that their maximum is confined to the peak of the 11-year cycle of solar activity, but it happens that it is manifested at its minimum.

We associate the sudden COVID-19 pandemic with the abnormally low solar activity in 2020 (Golubchikov, 2020). It turned out to be a record low for all 200 years of instrumental observations, and this extreme will maintain for years (Zharkova, 2020). Indicators of the state of many parts of the planetary

system were characterized by maximum deviations from the standard in 2020 (Reteyum, 2020). Reduced solar activity is associated with a decrease in ultraviolet radiation in the solar spectrum, which disinfects the atmosphere. This creates conditions both for the multiplication of viruses and for the reduction of immunity. This results in the emergence of a global viral epidemic, amplified by a decrease in the effectiveness of antibiotics.

Ultraviolet light also synthesizes vitamin D in the body and thereby strengthens the immune system. Vitamin D deficiency is highlighted in the spread of the COVID-19 pandemic (Benskin, 2020). In regions relatively poor in ultraviolet light, milk is considered a kind of replacement for vitamin D (Borinskaya et al, 2009). The most effective way to compensate for the deficiency of ultraviolet radiation is exposure to the sun in the mornings, better in solitude.

One of the most dangerous types of pollution - noted by Chizhevsky - is the air exhaled by people. People around us may be sick, yet not necessarily infectious. The air they exhale contains dangerous particles from human organisms. Small droplets from someone who sneezes, or coughs may contain the corona virus. If you inhale these drops, you will receive it instantly.

The Swiss physician Philip von Hohenheim Paracelsus, who lived in the 16th century, argued that plants purify the atmosphere by taking in everything exhaled by animals and people. Plants adopt diseases from humans and animals in the same way. Plants absorb into themselves all harmful elements, converting them into healing oxygen. Paracelsus's thoughts began to find confirmation with the discovery of phytoncides and terpenes.

The Italian botanists associate the low incidence of coronavirus in the southern regions of Italy, compared with the northern ones, with their greater forest cover. In this, they see a positive effect on the human immune system of inhalation of volatile compounds released by trees and recommend "forest bathing" and the practice of visiting forests in the fight against coronavirus (Roviello and Roviello, 2020).

Kaznacheev (2015) stated that the biosphere has the property to sanitize and eliminate pathogenic factors and viruses. But man, destroying the biosphere, deprives it of its sanitizing functions. Endemics, pandemics, tumour processes do not arise by chance. They should not be reduced to "*only that biochemistry, infections, toxicants, radiation that dominate today. This process is deeper*" (Kaznacheev, 2015, p. 10).

The cornavirus pandemic also has a meaning. Perhaps it lies in the restoration of the sanitizing properties of the biosphere. Or, perhaps, it is intended to reveal to us the importance of tourism due to its absence. Having these, a certain level of unpredictability must be considered in development, on which the freedom of choice is based, since the past experience is not always sufficient to predict the future. For instance, catastrophes in the history of the Earth and man serve to prevent more devastating events. Imagine that the catastrophe of the Great Patriotic War would take the countdown not from June 22, 1941, but from June 22, 1951. After all, there would have been immeasurably more victims and tragedies, only because the main players would have had atomic weapons by that time. On the other hand, had a global physical and geographical catastrophe happened in 1941, the war would have become meaningless. A catastrophe would even unite opponents in confronting the threat.

4. HEALING THROUGH THE LANDSCAPE

Everyone can establish for themselves the healing power of certain landscapes, trusting their sensations, experience and intuition. Moreover, depending on the state of the body and the seasonal meteorological conditions, addictions to certain places can change. For some, sunrises are a spectacular sight, others do not notice them. "*A person's own observations of what is good for them and what is harmful is the best medicine for maintaining health*" wrote Francis Bacon (1978, p. 422). Then when people succeeded in healing themselves, Aristotle understood that this would not be possible but through excellent understanding of the role nature has by its unity and uniqueness.

But man is more than nature. He is still spirit and soul. And nature is also something more than physics, chemistry, or biology. It is also poetry, beauty and art: *"There is a soul in it, there is freedom in it, / There is love in it, there is a language in it"* (F. Tyutchev).

Some general guidelines for choosing healing sites in a pandemic are still possible. In the works of Chizhevsky (1964, 1989) it was shown that not all oxygen is beneficial. City air can contain enough oxygen, but there are no negatively charged oxygen ions in such oxygen. Without them, the work of the brain suffers, depression and apathy appear. In the city, the air is enriched with positively charged oxygen ions. Outside cities, positive oxygen ions accumulate in places of stagnant air: in lowlands, basements, in swampy valleys. Air stagnation is especially dangerous in winter and in cloudy weather, with fog. Oxygen is most negatively ionized during mechanical fragmentation of water in a free atmosphere - for example, during the surf or heavy rain, near high waterfalls and fast mountain rivers. The air after a thunderstorm is highly saturated with negative oxygen ions, when it is filled with thousands of aromas of flowers, leaves, grass. All plants, and especially conifers, serve as an important source of negative oxygen ions (Chizhevsky, 1964).

As Chizhevsky stated, negatively ionized oxygen is the most wonderful and free medicine. Getting from the lungs into the blood, it saturates organs and tissues with energy. To activate the activity of oxygen in our body, it is necessary to learn not so much to breathe correctly, which hundreds of manuals are devoted to, but rather where to breathe. "*And therefore, it must seem strange the amazing fact that we pay great attention to what we eat, what we drink, and what an insignificant, almost imperceptible interest we show in what kind of air we breathe ... This fact is in deep contradiction with the huge accumulation of theoretical and experimental knowledge by the human society, which speaks of the greatest physiological role of clean out-of-town air*" (Chizhevsky, 1964, p. 13).

Almost sterile air is observed in a young pine forest, since pine is distinguished by a significant amount of phytoncides. It was found that volatile compounds secreted by foliage and needles - terpenes - have a positive effect on the formation of more so-called killer cells in the blood, which are responsible for the destruction of viruses, bacteria and even cancer cells that threaten health. It is worth taking a walk in the forest, and the number of such immune killer cells in the body rise by about 50% (Arvay, 2018). The practice of shinrin-yoku (forest bathing) is widely used in Japan. Its meaning is quite simple: to leave the house, get to the nearest forest and spend some time there, deeply breathing the forest air. For better results, you can also meditate or do yoga (Rozdorozhnyuk, 2020).

It has been known for over 1000 years in China that some places are rich in vitality and resources, while others are deserted, uninhabited and scarce (Jiang, 2014). For instance, a compass was invented with the aim of finding those and other places, and not for navigation, as it is written in textbooks. The ancient Chinese art of Feng Shui (the doctrine of "winds and waters") is focused on the search for energy-healing places. According to it, there is a planetary system of anomalous places and channels connecting them. In the areas where the channels intersect, either the vital energy Qi or the destructive energy of She accumulates (Kuprienko, 1999). In the European Middle Ages, Feng Shui was called geomantic geography. In essence, it is the ancient science of the geographic environment and how to harmonize with it (Yoon, 1982).

Landscape therapy has something in common with the ancient Chinese art. In Russian literature, the term "landscape therapy" was apparently the first to be used by Armand (1966, p. 7), although Voeikov (1898) should be considered as the founder of the direction. Nowadays, it is forgotten that the very Russian word "курорт" [kʊˈrort] (from German Kur - treatment, Ort - place) means "treatment by place", or, more precisely, "treatment by landscape". The term "therapeutic landscape" emerged in English-language literature in the 1990s (Gesler, 1992). It is defined as a metaphor for the self-healing processes that implicitly happen in specific places (or situations, conditions, settings, environments) (Milligan and Wiles, 2010, p. 743).

Healing is not synonymous with treatment. The goal of landscape therapy, like the science of tourism in general, can be considered to improve the quality of life, even if it goes against diseases and illnesses. As an indicator of a high quality of life, one can take good impressions from life with good health.

If medical tourism is associated with travel to visit a medical institution, health tourism, wellness tourism is focused on the treatment by using one or another type of natural resource (balneological, mud, climatic) (Connell, 2013), then landscape therapy is based on the healing power of the entire landscape complex, including all components of the landscape. It does not necessarily involve moving outside the permanent home, like tourism. This could be a simple long-distance hike.

Types of tourism with sports elements coexist with landscape therapy: hiking - a short walking trip through picturesque places; trekking - a long trip through mountainous terrain with overnight stays in designated places.

Landscape therapy is closely intertwined with horticultural recreation. In a pandemic, it can be viewed not only as an adaptive strategy to the projected economic downturn. There is a deep healing meaning in growing your own food. Until a hundred years ago, people mainly consumed products grown in the same geographic environment as they lived. Since then, all through hundreds of generations, a deep relation between food and humans has formed, up to the genetic level. Products from the centre of the emergence of cultivated plants, alien to the people, are, in a certain sense, genetically altered for them. Cells alien to the body are built from foreign products. New diseases come with them - cancer, stroke, atherosclerosis, diabetes, dysbacteriosis, pandemics. Their number is constantly growing, they are rapidly getting younger. At the same time, people blame anything for their illnesses, but not food. It is believed that earlier these diseases could not be diagnosed; hence there were no such names. But it is becoming more and more clear that they really did not exist. During World War II, when food was issued on ration cards or was grown independently, cardiovascular, cancer and other diseases plummeted across Europe. Hence, it follows that any organism needs the nutrition that is assigned to it by the nature of generations and the geographical habitat (Golubchikov, 1998). Since immemorial times, numerous berry, nuts, salad and vegetable plants, mushrooms have been inherent in our diet. Compared to cultivated plants, they are not inferior, but rather significantly superior, in terms of nutrition and taste, we cannot even compare them, at all.

Closely related to the natural science components of human science, landscape therapy links medicine, psychotherapy and landscape science. However, around mutual intersection of many disciplines, as a rule, this area is pushed to the periphery of each of them.

Hence, it is not surprising that we do not know of any books or teaching aids on the topic of landscape therapy, either in our country or abroad. There are small articles, but there is no monographic overview of the problem. There are many publications about the medicinal properties of forests and plants, seas, climate, rivers, but not about their natural combinations. With a huge abundance of books on the medicinal properties of individual plants, there are no books on phytocenosis treatment.

If even an insignificant part of those funds were allocated for the development of landscape therapy, which are aimed at the development of chemical and drug methods of treatment, then it would probably become an effective means of healing. The development of a methodology for the use of this primordially inherent healing remedy is still ahead.

5. PANDEMIC IN THE PRESERVATION OF ARCHAIC LIFESTYLE AND TECHNIQUES

In case of not only unfavourable, but also uncertain, epidemiological situation, it is more important than ever to preserve and develop all kinds of traditional, old, obsolete technologies and unnecessary things. Indeed, with the growth of the complexity of the technosphere, there is a simplification of its diversity and the risk of a catastrophic outcome. Modern civilization is very unstable in this regard. All of it, for example, hung on electricity. Nothing works without it, neither the army nor the police. Electricity can be suddenly cut off, even reaching catastrophic levels, as the pandemic develops, or even due to the transition to renewable, but unstable energy sources - wind and sun.

Therefore, the preservation of samples of all kinds of archaics such as steam locomotives, steamers, carburetor cars, biplanes, sailboats, airships, balloons or riding horses, wood-fired heating or water supply on wells becomes, perhaps, even more important than all sorts of digital innovations and the hi-tech itself. Meanwhile, each fundamentally new achievement of technical progress negates the development of its other directions, which are translated by more successful colleagues into symbols of technical backwardness.

It remains to be seen what success the locomotive building would have achieved if it had not been completely excluded from development. Its history dates back almost 200 years, when in 1956 the last steam locomotive was built in our country; in China - in 1988. The fact that transport on a retro steam locomotive was organized along the Circum-Baikal Railway is also important from the standpoint of national security. And, even earlier in time, nations ended the millennial era of the sailing fleet. The last large sailing ship was built in 1926 (the «Kruzenshtern» bark, which the former German Padua passed to the USSR on reparation).

Today's reality is that history, without being formalized into a tourist product, is consigned to oblivion. Venice would not have survived without tourism and "museization". Nature is no exception. The system of specially protected natural areas (reserves, national parks, wildlife sanctuaries) simply will not survive without the constant interest of the population in it, carried out by tourism.

There are many works describing the threats posed by tourism to natural and cultural heritage sites. Much less is said that these objects themselves exist primarily thanks to tourism. It was with this interest that the revival of the destroyed churches and monasteries of Russia began in the late 1950s. At first, it concerned only samples of architecture of the 16th - 17th centuries, but without the local history movement of those times, such a restoration is also impossible to be imagined.

The same way churches used to disappear (by demolition) in the past, the same way villages, settlements, farmyards, camping-grounds, isolated arable lands are disappearing today. There are successful examples of restoration of Russian estates, but there is absolutely no experience in the rehabilitation of cultural landscape of a bygone village with its barns, baths, wooden carvings, household appliances, traditions. Meanwhile they have saved us more than once in those inhuman conditions of the past, so they may very well be in demand in the future.

6. CONCLUSIONS

Deurbanization and social distancing drives many city dwellers to their second homes (dacha) in the countryside or stimulates house trade and construction in the rural areas. This expands the possibilities of the body's recovery. One of the main methods is landscape therapy, along with the cultivation of their own agricultural products by the townspeople in the landscape-geochemical environment familiar to them. The intensification of dacha recreation phenomenon in relation to the pandemic and its spatial expansion will create the preconditions for the restoration of abandoned village settlements, the development of rural tourism and the preservation of old and traditional living techniques. Countryside nature management, like rural tourism, combines two most contrasting spheres: agriculture, as the oldest and most basic foundation of the global economy, with tourism and recreation, one of the newest and fastest growing economic sectors.

The sudden pandemic is associated with abnormally low solar activity in 2020 and, accordingly, weakened UV disinfection capacity of the atmosphere. The coronavirus pandemic increases the importance of secluded landscapes, trekking walks, local history, and rural tourism. If, we consider the anthropogenic principle, according to which the entire Universe and the biosphere were set to meet the man's needs, then even more, we need to acknowledge that the same principle applies to the geographical space. This opens opportunities for harmonizing the body with natural landscape for the purpose of healing. Therefore, the coronavirus pandemic enhances the importance of dacha recreation, secluded landscapes, therapeutic walks, local history, and rural tourism.

With the pandemic, the world has come to another crossroad. There were concerns about the "end of tourism", though this is not quite the end of tourism, but a reboot. Dacha environmental management, rural tourism and landscape therapy have become a recreational response of the Russian population to the COVID-19 pandemic. The pandemic serves as a turning point in the reorientation of geography and ecology towards understanding and advocating for nature preservation to be able to sustain human society in a continuous transformation.

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