
ЗАГАЛЬНІ ПРОБЛЕМИ ЕКОЛОГІЧНОЇ БЕЗПЕКИ

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METHODOLOGY OF COUNTERACTION TO ENVIRONMENTAL THREATS, RISKS AND ENVIRONMENTAL TERRORISM: A SYSTEM APPROACH

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The article discusses the methodology for countering environmental threats, risks that arise in conditions of environmental terrorism, accidents of technologically dangerous objects. Modern environmental threats of Donbass are analyzed. The system factors of “environmental terrorism” are considered. A strategy and directions for preventing and combating environmental terrorism are proposed. *Key words:* environmental safety, environmental terrorism, environmental risks and threats, systematic approach.

Методологія протидії екологічним загрозам, ризикам і екологічному тероризму: системний підхід. Бондар О.І., Машков О.А., Жукаускас С.В., Нігородова С.А. У статті розглядається методологія протидії екологічним загрозам, ризикам, які виникають в умовах екологічного тероризму, аварій техногенно небезпечних об'єктів. Аналізуються сучасні екологічні загрози Донбасу. Розглянуто системні чинники «екологічного тероризму». Запропоновано стратегію та напрями запобігання й боротьби з екологічним тероризмом. *Ключові слова:* екологічна безпека, екологічний тероризм, екологічні ризики та загрози, системний підхід.

Методология противодействия экологическим угрозам, рискам и экологическому терроризму: системный подход. Бондарь А.И., Машков О.А., Жукаускас С.В., Нигородова С.А. В статье рассматривается методология противодействия экологическим угрозам, рискам, которые возникают в условиях экологического терроризма, аварий техногенно опасных объектов. Анализируются современные экологические угрозы Донбасса. Рассмотрены системные факторы «экологического терроризма». Предложены стратегия и направления предотвращения и борьбы с экологическим терроризмом. *Ключевые слова:* экологическая безопасность, экологический терроризм, экологические риски и угрозы, системный подход.

Introduction. In accordance with the Law of Ukraine “On the Fundamentals of the National Security of Ukraine” of June 19, 2003., No. 964-IV, the national security of a state is the security of the vital interests of a person and citizen, society and the state, which ensures the sustainable development of society, timely identification, prevention and neutralization of real and potential threats to national interests [12].

At the present stage, the main real and potential threats to the national security of Ukraine, in the environmental field are [1; 3; 5–9; 13–15]:

- a significant anthropogenic disturbance and man-made congestion of the territory of Ukraine, an increase in the risk of emergency situations of man-made and natural characters;
- irrational, exhausting use of mineral and raw natural resources;
- the insufficiency of the negative social and environmental consequences of the Chernobyl disaster, the fighting in the Donbas;

- deterioration of the ecological status of water basins, aggravation of the problem of transboundary pollution and reduction of water quality;

- exacerbation of the technogenic state of hydraulic structures of the cascade of reservoirs on the river. Dnieper;

- uncontrolled importation into Ukraine of environmentally hazardous technologies, substances, materials and transgenic plants, pathogens dangerous to people, animals, plants and organisms, the environmentally unjustified use of genetically modified plants, organisms, substances and derived products;

- the ineffectiveness of measures to overcome the negative effects of military and other environmentally hazardous activities;

- the danger of environmental terrorism;

- increasing the influence of harmful genetic effects in populations of living organisms, in particular genetically modified organisms, and biotechnologies;

– obsolescence and lack of effectiveness of complexes for the disposal of toxic and environmentally hazardous waste.

The **purpose** of the publication is on the basis of a systematic approach to consider the methodology for countering possible environmental threats, risks and environmental terrorism.

The presentation of the main material. According to the Law of Ukraine (8068) “On National Security of Ukraine” dated June 21, 2018 (Section II BASIS OF NATIONAL SECURITY OF UKRAINE, Article 3. Principles of state policy in the areas of national security and defense, p.4.) “State policy in the fields of national security and defense is aimed at ensuring the military, foreign policy, state, economic, information, environmental security and cyber security of Ukraine, etc.” In the article, from the standpoint of a systematic approach, threats in the field of environmental security and their impact on the state of national security are considered [4].

The urgency of researching the problems of finding ways of ecological revival of Donbass is focused on ecological principles by many researchers, in particular A. Bondar, A. Nastasenko, O. Ulitsky, V. Ermakov, E. Ozerova. Environmental threats in certain areas are annually systematized in the “National Report on the State of the Environment in Ukraine” of the Ministry of Ecology and Natural Resources of Ukraine. At the same time, an insufficiently studied issue is the systematic consideration of threats in the field of environmental safety as part of national security [3, p. 11].

According to the National Security Strategy, the following environmental security threats are highlighted:

- excessive anthropogenic impact and a high level of anthropogenic pressure on the territory of Ukraine;
- negative environmental consequences of the Chernobyl disaster and the fighting in the Donbas;
- a significant amount of waste production and consumption and inadequate level of their recycling, recycling and disposal;
- insufficient state of the unified state environmental monitoring system.

The state of the environment is characterized by an abnormal level of anthropogenic pressures on land, water, biotic, and mineral resources, as well as the growing influence of the effects of global climate change, including warming, an increase in precipitation intensity, etc. The active manifestation of anthropogenic pressures is associated with a high level of urbanization in Ukraine. The total area of cities and towns is 19 thousand km² or 3% of the state’s territory, with about 70% of the population [2, p. 12].

The high level of technogenic load on the territory of Ukraine is due to the presence of a complex of mining, chemical, energy facilities, a significant number of industrial-urban agglomerations and a high population density in the industrialized regions of the country. For a long time, about 60% of state export earnings were

provided on the basis of the extraction and processing of mineral resources. And this leads to the formation of a large amount of waste, emissions of pollutants into the atmosphere and discharges into surface water bodies.

In general, this leads to a significant increase in the risk of man-made disasters with large-scale negative consequences. There is a threat of destruction of high-risk facilities as a result of the commission of terrorist or sabotage acts (for example, railways, oil and gas pipelines, bridges, trunk grids). In Ukraine, about 6 thousand potentially dangerous objects are concentrated in the territory of Donetsk, Lugansk and Kharkov regions with a high population density. At the same time, a significant part of them are operated in conditions of exceeding the regulatory deterioration of fixed assets, the dangerous reduction in the strength of foundations of structures as a result of flooding, and the effect of corrosion on structural elements.

In the mining areas of Donbass (as a result of military actions and systematic violations of the technological regulations of the drainage of mines and quarries) there is a threat of catastrophic flooding and flooding of nearby cities and towns. There is an unpredictable movement of explosive and toxic gases in industrial and residential buildings. Subsurface and surface water sources are polluted.

Now the negative environmental consequences of the Chernobyl disaster are manifested in the following areas:

- large-scale radioactive contamination of the environment (forests, soils, agricultural land, water bodies);
- the emergence of a large amount of radioactive materials and radioactive waste;
- the presence of the object “Shelter”, which continues to be a source of distribution of radionuclides into the environment. There are radiation risks in conditions of extreme weather events, as well as the risk of its destruction.

On November 29, 2016, the Chernobyl NPP hosted solemn events on the occasion of the successful completion of the construction of a new safe shelter (Arch) of the 4th power unit. This is the result of the international program for transforming the Shelter of the Chernobyl NPP into an environmentally safe system.

The project provides that the new facility will be operated for 100 years. At the same time, there is a real threat to the population and the environment, taking into account the growing level of contamination of surface and groundwater with radioactive waste.

About 450 million tons of waste are generated in Ukraine each year, while only up to 15% of solid waste is recycled. The total amount of accumulated waste in Ukraine is more than 35 billion tons. Landfills, landfills, storage facilities, sludge collectors, waste heaps occupy about 2.7% of the country’s territory.

The main problems are the lack of facilities for waste disposal, the ineffectiveness of environmental control and the necessary management practices, inefficient

regulatory and legislative standards, illegal waste disposal and the creation of spontaneous dumps, financial obstacles and the lack of a single organizational structure.

Now in Ukraine there is no system for the effective handling of industrial and household waste. Therefore, there is a threat of growth in the volume of their accumulation (by 7,200,000,000 tons or 20–25% by 2030). It is necessary to increase the area of territories for their storage.

The situation with waste management is significantly complicated by the lack of adequate infrastructure for the separate collection, sorting and disposal of solid household waste.

The lack of a National Waste Management Strategy is a significant obstacle to the sustainable development of the domestic waste recycling sector, a kind of barrier to attracting the necessary investments in environmental protection.

Conducting an objective assessment of the environmental safety of the regions is complicated by the unsatisfactory state of the environmental monitoring system. Now in Ukraine there is no operational unified environmental monitoring system. At the same time, only departmental monitoring systems are functioning (narrow-profile tasks are solved).

It is necessary to continue improving the state environmental monitoring system. Proposals for the development of the environmental monitoring system are present in the Basic Principles of the State Environmental Policy of Ukraine for the period up to 2030. Among other tasks, the National Security Strategy of Ukraine (Presidential Decree dated May 26, 2015 No 287/2015) proposes the creation of an effective environmental monitoring system (paragraph 4.14). The Decree of the President of Ukraine dated April 25, 2013 enacted the decision of the Council of National Security and Defense of Ukraine “On the set of measures to improve environmental monitoring and state regulation in the field of waste management in Ukraine”.

According to the National Security Strategy, the priorities for ensuring environmental security are:

- preservation of natural ecosystems, support for their integrity and life support functions;
- creation of an effective environmental monitoring system;
- resource conservation, ensuring balanced environmental management;
- reducing the level of environmental pollution, ensuring control of sources of air pollution, surface and groundwater, reducing pollution and reproduction of soil fertility; cleaning of territories from industrial and household waste;
- formation of a system for processing and disposal of production and consumption wastes;
- minimization of the negative consequences of the Chernobyl disaster;
- prevention of uncontrolled importation into Ukraine of environmentally hazardous technologies, substances, materials, transgenic plants and pathogens.

In modern conditions, the tasks of preserving natural ecosystems, creating an effective system for monitoring the environment, ensuring balanced environmental management, reducing the level of pollution of the environment, forming a system for processing and recycling production and consumption waste are becoming topical. It is necessary to prevent the occurrence of emergency situations of man-made and natural nature.

Modern environmental threats of Donbass

Military operations in the east of Ukraine led to serious environmental problems in the Donbas. The ecological state of the eastern regions of Ukraine before the outbreak of hostilities could be described as critical. There was a long use of natural resources. There was a negative impact on all environmental objects. There were dangerous changes in the ecological state of the environment in the Donbas: excessive air pollution, water resources; soil contamination; destruction of land resources; loss of natural reserve fund; the consequences of the destruction of the mines; handling hazardous wastes; destruction of industrial environmentally hazardous objects (objects of critical infrastructure).

Analysis of samples in the air did not reveal significant excess of the maximum permissible concentrations of pollutants compared with background concentrations. This is determined by the fact that the explosive components of ammunition (trinitrotoluene, hexogen, mixtures of nitro compounds with powdered aluminum) quickly decompose in the natural environment. Air pollution (as a result of hostilities) can be determined by the increased content of nitrates and metals that were used in the production of rockets and shells.

The negative consequence of the conflict in the Donbas is a significant pollution of the soil cover. As a result of flooding of the territories, emissions of harmful substances have increased. When a large-scale spill and combustion of fuel and lubricants occurred, soil pollution in large areas. Thus, the area allotted for arable land, for example, in the Donetsk region, reaches 64% of its territory. This led to a significant drop in the quality of agricultural production and a reduction in agricultural land used. Soil pollution also occurs as a result of the combustion of a large amount of ammunition during the direct conduct of hostilities.

One of the most negative and destructive impacts on land resources in the war zone is the explosions of shells. These explosions poison the earth with chemicals and litter it with metal fragments. Tens of tons of chemicals and metal debris made unsuitable for use of the territory of agricultural land. Therefore, the problem of humanitarian demining of the territory of Donbass is important.

The fighting on the territory of the Donetsk and Luhansk regions also led to land pollution and disruption of the landscapes of the nature reserve fund. The monitoring showed that the territories of the branch of the Ukrainian State Steppe Natural Reserve “Khomutovskaya Steppe”, the national natural parks “Meotida” and “Svyatye Gory”, regional landscape

parks and reserves “Donetsk Ridge”, “Slavic Resort”, “Kramatorsk”, “Zuevsky”, “Kleban-Byk”, offices of the Lugansk natural reserve “Provalsky Steppe”, “Trekhibzensky Steppe”, “Stanichno-Luganskoe”. Objects of the natural reserve fund of Donbass also suffered from the construction of fortifications, cutting down of forest plantations, forest and steppe fires. We believe that joint environmental monitoring with the participation of international experts, such as the OSCE and the UN (using satellite monitoring data and the use of aerospace technology), is especially important for the territories of Donetsk and Lugansk regions that are not controlled by Ukraine.

Mine are a significant danger. They require uninterrupted power supply. Disconnection from power supply of ventilation systems leads to industrial accidents and salvo emissions of mine gases (methane and hazardous impurities). Disruption of power supply systems of water disposal leads to the flooding of mines, flooding of adjacent territories, pollution of groundwater and surface waters with mine waters with a high salt concentration. Flooding of land leads to their removal from economic exploitation, destruction of buildings. Methane gas under pressure rises to the surface through cracks in the soil, creating explosive situations in nearby objects.

As a result of the hostilities, more than 20 mines in the occupied territories were either threatened with flooding, or completely flooded and are not subject to further exploitation. The exact number of flooded mines is difficult to call. It is reliably known about the full or partial flooding of the Parentskaya and Yasinovskaya-Glubokaya mines in Makeyevka; Mospinskaya, Trudovskaya and Oktyabrskaya mines in Donetsk; “Belorechenskaya” in the Lutuginsky district of the Luhansk region (no longer subject to recovery); mine them. Melnikova in Lysychansk; “Komsomolets Donbass” in the Kirov district of Donetsk region; them. Vakhrusheva in Rovenki; them. Korotchenko in Selidovo; destroyed Progress mine in Torez, Krasny Partizan in Sverdlovsk, Ilovaisk mine, Volynskaya, in Rassypny, Luganskaya, Mashinsky Blok, Maria Glubokaya and many others.

The flooding of a significant number of mines is dangerous because they used to be used as waste storage facilities. Such in particular is the mine “Gorlovskaya” 2-bis and the mine “Yunkom” under Enakievo (in the mine “Yunkom” in 1979 a nuclear explosion was made). Polluted waters from the neighboring Poltava and Uglegorskaya mines begin to enter the Yunkoma mine. In case of its overflow, radioactive substances will rise to the surface, as a result of which the level of radioactive contamination will exceed the norm hundreds of times.

The flooding of conventional mines has dangerous environmental effects. The danger is mine methane, which when flooded rise to the surface. There is a danger of gas accumulation in the rooms and possible explosions. Mine water is very saline. As a result of their release to the surface all underground water horizons will be salted. The water in the wells becomes unsuita-

ble for consumption. Salted and swamped ground. After 2–3 years, saline deserts and swamps will be formed at the place where the waters emerge to the surface, which will be unsuitable for economic use.

It is necessary to eliminate waste heaps, tailings. Dumps filled with toxic mining waste occupy large areas on the surface of the earth. They contain useful chemical elements and polymetallic ores (including lead, silver, aluminum, copper, zinc, and others). It is advisable to alter these waste dumps using modern technologies (valuable polymetallic ores and elements must be removed). It is advisable to use slags to fill spent quarries, earth dips, and the like.

A particularly acute environmental problem in Donbass is the problem of handling hazardous waste. Places of storage of toxic waste in enterprises often do not meet environmental requirements. This contributes to their entry into unauthorized landfills and other unsuitable for this place.

The current situation with waste in the combat zone requires the adoption of an emergency measures. It is the first steps that consist of inventorying the waste and objects of their accumulation, assessing the damage, localizing each of the problems, and developing a detailed plan for their elimination depending on the level of danger.

Objects of critical infrastructure pose a significant environmental threat: Avdeevka Coke Chemical Plant, Dzerzhinsky Phenolic Plant, Donetsk Filtration Station, Lisichansk Oil Investment Company, Bakhmut Agrarian Union Farms, and so on. The analysis carried out shows that severe environmental consequences.

The purpose of the restoration of Donbass on environmental principles are: solving urgent problems of environmental and economic development of Donbass; ensuring national security and protecting the geopolitical interests of the state; the preservation of a safe for the living and inanimate nature of the environment; protection of life and health of the population from environmental pollution; achievement of harmonious interaction of society and nature; protection, rational use and reproduction of natural resources of Donbass.

Provides for the implementation of measures for the environmental restoration of Donbass in stages. The first stage is to carry out environmental monitoring (using aerospace tools) and determine ways to clean up areas from the effects of hostilities and military dangerous items. The second stage is humanitarian demining of territories, restoration of urbanized territories (houses in villages, towns and cities) and communications, as well as restoration of agricultural landscapes (leveling the terrain by filling holes (craters) from shells and mines, rehabilitation of farmlands and fields). The third stage is the development and implementation of programs for the development of local settlements, industrial and agricultural facilities.

We believe that aerospace monitoring will allow for a survey of the ecological status of water sources (water

intakes, wells, wells); evaluate and forecast possible changes in water quality; determine the areas of critical state of the engineering infrastructure (water and sewer complex, heat energy supply, water treatment, hazardous industrial facilities, etc.); to carry out the identification and mapping of "illegal mines", spontaneous places for storing waste, places of landscape disturbances as a result of combat actions conduct a survey of land resources and soils, determine their chemical composition.

It is necessary today to have a plan for an integrated and systematic vision of steps to overcome the environmental consequences of hostilities in the east of Ukraine, which will contribute to the implementation of the State Target Program for the restoration and development of peace in the eastern regions of Ukraine.

Strengthening the ecological block of this program will make it impossible to return to the outdated structure of the regional economy, ensure the modernization of all aspects of the life of the eastern regions of Ukraine on the principles of sustainable development and "green" economy. It is necessary to restore the energy sector of Donbass using modern energy-saving technologies (biofuels, solar power, wind power) and the rational use of traditional energy sources and (where it is possible and has a future). It is necessary to overcome the low level of use of primary raw materials, secondary resources and waste, to introduce little – and non-waste technologies. It is necessary to build (not restoration and not repair of damaged buildings) a new modern and prospective infrastructure of residential and industrial areas. Waste management (based on the results of hostilities) must be carried out in accordance with modern environmental standards.

Ecological terrorism: problems and threats to society

Today, about forty environmental problems of global, global significance are identified. These include, in particular, air pollution, the greenhouse effect, the threat to the ozone layer, acid rain, pollution of the oceans, radiation pollution, the disappearance of plant and animal species, reduction of natural habitats, increased waste, environmental imbalances, urban crisis, shortage of fresh water, population growth, social tensions, problems with food, energy problems, reduction of natural resources, etc. Therefore, in general, we can talk about a systemic environmental crisis [10; 11].

Prediction of global problems can be made on the basis of the development and study of computer scenarios of world development. According to these scenarios, in the second half of the 21st century, an ecological and social collapse is possible, which will be systemic and lead to a catastrophe. In a situation that develops, any actions aimed at destroying the environment can cause catastrophic environmental consequences.

Accessibility for terrorists of complex types of weapons and explosive systems represents a potential threat of harm to the environment. The use of large-scale advanced explosive devices against objects (dumping

sites for hazardous waste, nuclear power plants, electrical controls of pumping stations in oil and gas pipelines) can have disastrous consequences.

Let us give just one example of "environmental terrorism". Within five years after the start of oil transportation on the Kano-Limon-Covenas oil pipeline, the Colombian National Liberation Army arranged 140 explosions on the oil pipeline. This 490 millionth oil pipeline (on the territory of Colombia) is owned by Ekoprolet Columbia and a consortium of European and American oil companies. As a result of the terrorist attacks, almost 640,000 barrels of oil spilled. Losses and losses of oil exports were estimated at over \$ 500,000,000. Also, recently, the threat of the use of radioactive materials, highly toxic substances and pathogenic microorganisms by radical elements for terrorist purposes has become more frequent all over the world.

The environmental crisis threatens the national security of any country. According to experts, these "unconventional" means may cause more serious damage than conventional weapons. Terrorists can consider these extremely dangerous means to undermine the economy of any country, causing harm to its environment and population. Dangerous encroachment of criminal elements on high-risk facilities can lead to emergencies that are comparable in scale to accidents at nuclear facilities.

Therefore, we can distinguish environmental terrorism as a new kind of high-tech terrorism.

Ecological terrorism is terrorism on dangerous, from the point of view of ecology, objects. Hazardous facilities include: all types of power plants; production of the nuclear fuel cycle and nuclear ammunition; chemical, petrochemical and oil refining, metallurgical, biotechnical enterprises; storage of raw materials and products; oil, gas and ammonia pipelines; as well as military facilities containing radioactive and toxic substances. The main part of such facilities is located in the port-industrial zones of cities and densely populated places. They create a constant threat of environmental disasters.

Ecological terrorism is intimidation of people through environmental impact. Ecological terrorism is much more dangerous than many other crimes of a terrorist nature. In environmental terrorism, violent acts are applied to citizens or their property indirectly, through the environment.

In modern history, environmental terrorism did not occur often. However, precedents of actions of an ecological-terrorist nature exist. In 2001, terrorists in the United States and other countries spread anthrax spores (anthrax) in envelopes of ordinary mail. The threat of a new plague seemed insurmountable. In January 2003, the intelligence services of Great Britain announced that they had arrested 13 terrorists who were trying to start production of a highly toxic chemical substance ricin. As established by the British intelligence services, all those arrested are members of a terrorist group associated with the al-Qaida group. The production of ricin has become part of a carefully planned environmental attack

in several countries of the European Union. This example of environmental terrorism could end in a global catastrophe. It is difficult to imagine the possible consequences of a terrorist explosion, for example, a nuclear power plant or a train with spent nuclear fuel...

Ecological terrorism has two main forms: encroachment on the life and health of citizens and encroachment on objects of the state and international economy.

Agricultural terrorism can also be considered as a form of environmental terrorism. It is known that the provision of state food is an element of the survival of the nation. Continuous food production ensures stability for all modern societies. Reduced agricultural production and livestock production can lead to poor nutrition, malnutrition and hunger. These factors, in turn, can create prerequisites for public discontent and unrest.

Today, the world's leading countries are aware of the extreme vulnerability of the agricultural sector and are planning countermeasures to protect the main grain areas from terrorists who can take advantage of biological means.

As a kind of environmental terrorism, technological terrorism can also be considered, which is understood as: illegal use of nuclear, chemical, bacteriological (biological) weapons or their components, nuclear, radioactive, highly toxic chemicals, pathogenic microorganisms; decommissioning, destruction or seizure of nuclear, chemical or other objects, life support systems of cities and industrial centers. Waterworks, which are usually located within large cities or upstream, are also a serious danger. When they are destroyed, people are dying, vast territories, economic and strategic objects are flooded.

Definition of the term "environmental terrorism". The following methods can be chosen to study the problems of "environmental terrorism": sociological (sociological survey in the form of questioning and interviewing, sociological research); system analysis methods; computer simulation methods. On the basis of a systematic analysis of modern processes, it is possible to develop a strategy and measures to prevent and combat environmental terrorism (environmental legal measures, criminal legal measures; international legal measures).

It should be borne in mind that currently there is no recognized concept (definition) of environmental terrorism. Also, there is no distinction between the concepts of "environmental terrorism" and "environmental activism (radicalism)" ("ecological terrorism" and "environmental terrorism") in the scientific literature.

Environmental activism (radicalism) in scientific and journalistic literature is often confused with environmental terrorism. Environmental activism refers to the actions of "green" journalists and the media in order to draw attention to the environmental problem. Mass media today form public opinion on one issue or another. However, the environmental activists blocking the train's track with spent nuclear fuel is a much less serious problem than the deliberate undermining of such a train by terrorists or, for example, an attack on a nuclear

power plant. Environmental terrorists are not those who protect the environment (even if sometimes too radical and illegal methods), but those who encroach on it.

It is necessary scientifically, and then at the legislative level to separate the concepts: "environmental terrorism" (crime) and "environmental activism" (actions to protect the environment).

Ecological terrorism is a crime aimed at pollution or destruction of the environment. Environmental activism (radicalism) is the activity of activists of environmental organizations and movements aimed at protecting the environment. Ecological terrorism requires much more attention than it is being given today.

The concept of environmental terrorism defines terrorism as an environmental impact. This concept is found, for example, in the work of Timothy Sheffield (Timothy Shofield) "The Environment as an Ideological Weapon: A Proposal for the Criminalization of Terrorism with Environmental Impact" ("The environment as an ideological weapon: a proposal to criminalize environmental terrorism").

The modern international community has not yet come to a common understanding of the term "terrorism". Different international documents give different definitions of "terrorism". The definition of the term "environmental terrorism" in international law, unfortunately, is not today. In the national legislation of Ukraine, as well as other states, the definition of "environmental terrorism" does not exist either. Therefore, such a definition must be introduced primarily at the international level. The most complete (reflects the nature of the commission of a terrorist act), the definition of terrorism is provided by the definition contained in Article 2 of the draft UN comprehensive convention on international terrorism: "... serious damage to public or private property, including public places, a state or government facility public transport system, infrastructure or the environment; or damage to property, facilities, facilities or systems referred to in paragraph 1 (b) of this article which entails or may entail large economic losses, when the purpose of such an act, due to its nature or context, is to intimidate a population or force organization to commit an action or to refrain from doing it."

Thus, environmental terrorism should be considered as unlawful or intentional infliction of significant damage to the environment in order to intimidate the population or force the government or international organization to take any action or refrain from committing it.

However, the proposed definition will be useful in determining responsibility for environmental terrorism in international and national criminal law acts. For other purposes, it is possible to propose a simpler definition, according to which ecological terrorism is the commission of terrorist acts with the help of environmental impact.

The definition of environmental terrorism is one of the first steps towards developing a possible strategy, taking measures to prevent and combat this type of crime.

The search for strategies to prevent and combat environmental terrorism

To prevent and combat this type of crime there are various approaches: hard (power) approach; moderate approach (human rights should not be limited under any circumstances).

The next important issue of strategy development is the issue of public awareness about security. It is imperative that they inform the public about the level of safety of facilities and emergency situations. Such an approach should be the basis of a strategy to combat environmental terrorism.

The next important issue of strategy development is the distribution of powers between the relevant authorities. A decision is needed on the extent to which environmental terrorism will be dealt with: an enterprise with hazardous production, state bodies, authorities, law enforcement agencies and special services.

Ecological and legal measures to prevent and combat environmental terrorism are of the greatest importance at the regional level. Among such measures, the following should be highlighted:

1. Assessment of emergency danger of man-made objects (regardless of the threat of an accident).
2. Assessment of the emergency danger of a man-made object in the event of a terrorist factor.

An objective assessment of the main parameters of the risk of the functioning of hazards plays a very important role in ensuring environmental safety. The population must clearly understand what consequences may arise as a result of an environmental terrorist act of varying degrees of complexity, be aware of the possibilities to minimize harm to their own health.

Ecological terrorism is a very serious crime that can encroach not only on public safety and public order, but also on the peace and security of humanity, as an object of crime, in the event of a terrorist act, for example, a nuclear power plant. Therefore, environmental terrorism as a criminal offense requires qualification recognition.

Methodology of counteraction to environmental threats, risks and environmental terrorism: a systematic approach

The special danger of "environmental terrorism" today is that terrorists can use for their own ends, achieve technical progress and there are a large number of dangerous objects of encroachment (atomic, electronic, chemical and environmental).

The problem of organizing opposition to "environmental terrorism" has acquired particular importance in connection with complex environmental processes, in particular with the situation prevailing in the Donetsk and Lugansk regions, the Crimea.

We propose to discuss a systematic approach to countering environmental terrorism and extremism. We must understand that the phenomenon of environmental terrorism has no boundaries, no religion, no nation, and therefore threatens the security of all human civilization. However, the result can be achieved only

when the efforts of the state and society unite on the principles of democracy, the protection of human rights, and the security of our lives. Systemic counteraction to "environmental terrorism" is aimed at activating the public sector, finding a favorable action and on the part of law enforcement agencies. "Ecological terrorism" (as an international transnational phenomenon) is considered as a system that requires management (resistance). At the same time, the power component also needs additions of the society itself, public institutions.

Environmental terrorist risk has a social nature and social meaning in all aspects: in sources and set of hazards, in the dynamics of growing threats into threats, in assessing and managing the vulnerability of the target, in assessing the realization of risk, and finally in countering the terrorist act. The environmental terrorist threat is associated with a fundamentally new risk status in the world. Environmental terrorist activity is a targeted, motivated action that includes the organization, planning, preparation, financing and implementation of the terrorist act itself, incitement to its implementation, recruitment, "arming", training and use of terrorists. The sociopolitical phenomenon of "environmental terrorism" is a multidimensional phenomenon. Philosophers, historians, political scientists, sociologists, lawyers, economists, psychologists, criminologists, representatives of other sciences should be engaged in its study and analysis. This is determined by the specificity and uniqueness of the problem under study, which requires an interdisciplinary approach.

As the analysis shows, when studying the phenomenon of "environmental terrorism", it is advisable to take into account four main characteristics. First, "environmental terrorism" is one of the forms of organized violence. Secondly, "environmental terrorism" pursues political goals and motives; this is a specific form of violence. Thirdly, the characteristic content of environmental terrorism is a conscious focus on numerous human victims, destruction of the environment and natural resources. Fourthly, actions that terrorists can implement against humanity have significantly expanded: mass poisoning, radioactive contamination, infection with dangerous diseases, the spread of epidemics and epizootics, and the like. Tools for the commission of terrorist acts can be explosive devices of a broad spectrum, radioactive, poisonous and other dangerous biochemical substances.

Ecological terrorism has inherited all the traits of violence from its historical predecessors changes in the process of historical development under the influence of social and social factors. This concerns not only the goals, means and methods of terrorist activities, but also the personalities of those who take part in it.

Systemic factors of "environmental terrorism"

Currently there is no legal interpretation of the term "environmental terrorism". According to the authors, the functional components of the concept of "environmental terrorism" should be highlighted:

1. *“Biological terrorism”*. This type of terrorism is manifested in intimidation of people by the use of bacteriological weapons or their components, pathogenic microorganisms. The use of biological means of warfare (bacteria, viruses, fungi, toxins or substances produced by these organisms) against the population in order to threaten to destroy or destroy as many people as possible is biological terrorism. Dozens of different biological agents can be used to make biological weapons. The action of each agent leads to different effects. Some types of biological weapons are designed to destroy crops and livestock. Compared with other types of weapons (nuclear, chemical, conventional) biological weapons are unique in their diversity. There are two types of biological weapons: liquid and dry powder. Biological weapons are relatively inexpensive and, in principle, easy to manufacture. Although its most complex and effective options require the use of expensive equipment and special scientific knowledge, in a primitive form biological weapons can be manufactured with simple equipment and with a limited level of training.

The three main uses of biological weapons are: contamination of food or water; infection of vectors, such as mosquitoes and fleas, that infect the population and livestock; the creation of poisonous aerosol clouds; contamination area.

Experts believe that the most likely is the use of biological weapons in the form of aerosol clouds. Such clouds can be created in various ways: bomb blast, spraying and the like. The damaging ability of biological weapons is determined by many factors: the amount of the agent used, the direction and strength of the wind, weather conditions.

The possibility of using biological weapons is less likely, although comparing the possibility of using biological and nuclear weapons, the likelihood of the use of biological weapons is more real. First, the relative ease of acquiring and using its individual species; secondly, its low cost, the possibility of covert use, the selectivity of action. The most likely is the use of biological weapons as deadly viruses of typhoid, anthrax, paratyphoid, botulism toxins and others in homes equipped with air ventilation systems. The objects of the attacks can also become storage of drinking water and cosmetic products.

Biological substances, materials that are of increased danger to others, are “biological agents and substances of biological origin (biochemical, biotechnological preparations, microorganisms pathogenic for humans and animals, etc.)” (paragraph 4 of article 1 of the Law of Ukraine “On Objects heightened danger” dated January 18, 2001 No. 2245).

2. *“Chemical terrorism”*. Chemical terrorism is manifested in intimidation by the use of chemical weapons or their components, highly toxic chemicals. Chemical terrorism is a new threat to the security of mankind, the scale of which far exceeds the consequences of the use of modern firearms. This type of terrorism is defined as

a method of using chemical agents by terrorists to create a threat to the lives of people.

The basis of chemical weapons is poisonous substances – chemical compounds that can penetrate with the air into various structures and hit people in them. They retain their striking effect in the air, on the ground, in various objects for quite a long time. Spreading in large volumes of air and over large areas, they affect all people who fall into the sphere of their action without protective equipment.

The following substances are used as toxic substances: sarin, soman, V-gases, mustard gas, hydrocyanic acid, phosgene, lysergic acid dimethylamide. It is assumed that for the unexpected use of chemical agents, terrorists can use means of their dispersion in the air, poisoning of water bodies, and agricultural lands.

Chemical weapons are quite attractive for terrorist use for the following reasons: the availability and possibility of a completely legal acquisition of components of chemical weapons; the ability to covertly deliver chemical components to the site of the terrorist attack; information openness for the creation of chemical weapons; high damaging ability, especially in densely populated areas. These qualities of chemical weapons contribute to the growth of the threat of a terrorist act with its use. The danger increases with the increased ability of terrorists to have industrial toxic substances at their disposal. An example of the use of chemical weapons directly for terrorist purposes is an attack launched by militants of the Aum Shinriki sect in 1995 in the Tokyo metro. She showed that the danger of the use of chemical and other weapons of mass destruction by terrorists has become a reality.

Chemicals that pose an increased risk to others are chemicals that, directly or indirectly, can lead to death, acute or chronic disease or poisoning of people and (or) harm the environment (order of the Ministry of Ukraine on emergency situations and protection of the population from the consequences of the Chernobyl disaster, the Ministry of Agrarian Policy of Ukraine, the Ministry of Economy of Ukraine and the Ministry of Ecology and Natural Resources of Ukraine from 27 May that 2001 № 173/82/64/122).

3. *“Radiation terrorism”*. It manifests itself in intimidation of the illicit use of nuclear weapons or their components, nuclear, radioactive substances. Terrorist attacks usually aim to achieve an “instant dramatic effect.” Such an effect can be obtained using radioactive materials. Thus, an attack by a small group of lightly-armed terrorists on a nuclear facility or a statement about the use of nuclear weapons, radioactive materials may not cause real damage, but they will give a huge psychological effect, will cause hysteria, give birth to fear.

The factors that cause the greatest concern include such a negative phenomenon as illicit trafficking in nuclear radiation materials and sources of ionizing radiation. The growing threat of proliferation of nuclear materials in recent times due to the following reasons:

- the release of a significant amount of nuclear material as a result of a reduction in nuclear weapons;
- an increase in the number, growth of influence and financial capabilities of terrorist groups, transnational organized criminal groups, religious secessionist movements, religious sects.

The act of “nuclear radiation terrorism” is understood:

- use (or threat of use) of nuclear-radiation-materials, materials, nuclear fuel, waste of radioactive substances, sources of ionizing radiation in combination with disruptive or toxic substances;
- use (or threat of use) of nuclear facilities, nuclear explosive devices, radiation dispersing devices, as well as their components, which may be carried out by individuals, groups or organizations through the illegal seizure and use of nuclear radiation materials, nuclear waste and isotope products to achieve their political, economic or other goals.

The illicit trafficking of nuclear-radiation materials not only increased the existing threats in the nuclear sphere, but also created a completely new threat of “nuclear terrorism”.

The IAEA report noted that by terrorists or other intruders, some sources of radiation can be used for criminal purposes, for example, for the manufacture of so-called dirty bombs. Radioactive sources, which are widely used throughout the world in agriculture, industry, medicine, research institutions, do not have such a system of control and accounting that exist for nuclear materials.

According to the IAEA, more than 10 million sources of ionizing radiation are used in the world today. A huge amount of radioactive waste has been accumulated in Ukraine today. The total volume of radioactive waste is about 3,300–4,600 thousand m³, and every year only 13,000 m³ of liquid radioactive waste and 28,000 m³ of solid radioactive waste are generated at NPPs alone. The current state of affairs in the field of radioactive waste management does not allow for providing the necessary level of protection, which increases the likelihood of terrorist acts.

4. *“Technological terrorism”*. This type of terrorism is aimed at intimidating the destruction or deterioration of the conditions of functioning and efficiency of man-made objects. The definition of “technological” terrorism was legally defined in the Treaty of the Commonwealth of Independent States in the fight against terrorism. “Technological terrorism” means two groups of crimes of a terrorist nature:

- first, these are actions performed with the use of new technical means (chemical, biological, nuclear, radiation);
- secondly, these are actions directed against especially dangerous objects and objects of life support, the destruction of which leads to grave consequences (massive population death, pollution of the territories).

In a broad sense, “technological terrorism” can be defined as a set of innovative ways to carry out terrorist actions (which today include aerospace terrorism).

The social danger of “technological terrorism” is that the very fact of attacking objects violates the normal (safe) operation of them, threatens accidents, catastrophes, emergencies, death and harm to their health, as well as the environment, material and cultural values.

The consequences of terrorist actions in the destruction of hydraulic structures, chemical plants, nuclear fuel cycle facilities may have the scale of a regional and even national catastrophe. The destruction of control systems, energy supply, water supply and communications of large cities can paralyze their livelihoods and lead to mass panic, economic losses, and death of the population. Industrialized regions with high population density are the most vulnerable to the effects of damaging factors of man-made nature.

5. *“Natural terrorism”*. This type of terrorism is manifested in the following areas: intimidation of destruction of objects of the nature reserve fund, pollution of the aquatic environment, soil and air, destruction of biological diversity.

6. *“Agricultural terrorism”* manifests itself as a violation of the stability of food production, a decrease in agricultural production and animal husbandry. The goal of “agricultural terrorism” is to worsen nutrition, malnutrition of the population and hunger.

Today, it can be stated that environmental terrorism is trying to adopt the most advanced technologies that can entail mass destruction of the population, cause significant environmental and economic losses.

Systemic measures to combat and prevent “environmental terrorism”

The following systemic measures are proposed to prevent environmental risks and combat “environmental terrorism”.

1. *Improving the legal framework*. The legal framework for combating terrorism in Ukraine, in our opinion, is insufficient and needs to be improved. “Ecological terrorism”, as a separate corpus delicti, is not provided for in the current legislation of Ukraine. Along with this, in the Criminal Code there are a number of articles that provide for responsibility for the acts, which are defined as manifestations of a terrorist orientation. Thus, Article 258 of the Criminal Code of Ukraine, for example, is called the “Terrorist Act”. In Ukraine, it is necessary to enshrine in law a legal definition of the concept of “environmental terrorism” and a special provision on responsibility for its commission. The absence in Ukraine of a clear legal definition of the concept of “environmental terrorism” does not make it possible (from the point of view of criminological science) to fully disclose the essential characteristics of this danger and to work out ways to prevent and counter it. Special legislation should be created to combat “environmental terrorism” in Ukraine. The targeted law on countering “environmental terrorism” would allow: to legislatively determine the organizational and legal framework for combating manifestations of “environmental terrorism”; define it as a political and socio-economic phenomenon;

Legislatively identify state law enforcement agencies whose functions would be to prevent environmental threats, environmental risks and stop “environmental terrorism” in Ukraine.

2. *Information support.* As the experience of European countries shows, it is necessary to adjust the timely flow of information about the activities and intentions of extremist groups. It is necessary to create an effective state-wide system of coordination of anti-terrorist environmental activities using the available forces and means of ministries and departments and the potential of society. And this is impossible to do without information analysis and fundamental research of “environmental terrorism”. Therefore, adequate coverage of terrorist attacks in the media, coupled with the report of the ideology of countering “environmental terrorism” and extremism is the best help to the security sector.

3. *Cooperation with international organizations.* It is necessary to actively cooperate with international anti-terrorist organizations and institutions. This will allow improving international legal mechanisms to eliminate contradictions in approaches to the assessment of international terrorism and the root causes of its occurrence. There is an urgent need to coordinate the actions of special antiterrorist units for environmental response with new tasks of their international use and the possible prospect of deploying antiterrorist groups under UN auspices.

The international experience of counteracting “environmental terrorism” in recent years shows that individual states are not able to independently confront certain large-scale emergency situations of a technogenic and natural character and environmental threats. Effective organization of protection of the population and territories (based on risk management of environmental threats to accidents and disasters) at the national level is impossible without wide and active international cooperation.

The reasons that lead to uniting the efforts of various countries in order to meet the challenges of managing risks of environmental disasters include:

- global nature of man-made and natural emergency situations;
- the possibility of transboundary distribution of the effects of emergency situations;
- Ukraine’s international obligations to prevent man-made and natural disasters, as well as to inform, neutralize and assist in case of their occurrence;
- the need to integrate Ukraine into the European network for monitoring technological and natural risks;
- economic benefits from international cooperation in the field of man-made and natural emergency situations.

The priority direction for Ukraine is the development and formation of international economic mechanisms for regulating interstate risks of emergency situations of a technogenic and natural character with transboundary consequences. To create a legal framework for cooperation in the fight against environmental terrorism, it

is necessary to conclude appropriate anti-terrorism conventions. For example, by analogy with the Conventions that exist in other industries: the Convention on the Physical Protection of Nuclear Material, 1980 (entered into force in 1987); Protocol for the Suppression of Unlawful Acts against the Safety of Fixed Platforms Located on the Continental Shelf (1988); International Convention for the Suppression of Terrorist Bombings (1997); International Convention for the Suppression of Acts of Nuclear Terrorism (2005).

International cooperation in the fight against environmental terrorism can be carried out as follows:

- 1) the establishment at the international level of common approaches to bringing to criminal responsibility for environmental terrorism and its manifestations;
- 2) the development and conclusion of international treaties in the field of combating environmental terrorism, the adoption of other international documents as a legal basis for regulating the activities of states and international organizations in this field.

International cooperation in the fight against environmental terrorism, in our opinion, should be based on the following principles:

- 1) the principle of condemnation of “environmental terrorism”, regardless of the goals of terrorists (enshrined in almost all international conventions on combating terrorism);
- 2) refusal of any form of assistance to environmental terrorists (financial, technical, etc.);
- 3) cooperation at the global level in the fight against the financial and technological capabilities of environmental terrorists;
- 4) protection of objects of the nature reserve fund, world cultures and religions from the extremist influence of ecological terrorism;
- 5) compliance with international law.

4. *System technologies to combat environmental terrorism.* It is expedient to refer to the system technologies of combating environmental terrorism:

- prevention, blocking of “environmental terrorism” at the initial stage;
- Preventing the ideological justification of environmental terror under the slogans of “protecting nature”, “protecting the nation”, etc.; disclosure of the essence of terrorism by all possibilities and especially by the mass media;
- involvement of professionally experienced intelligence services in the antiterrorist activities;
- the implementation of negotiations with terrorists only by these special services and only to cover the preparation of the action for the complete destruction of terrorists;
- no concessions to terrorists, not a single unpunished terrorist attack, even if it costs the blood of people (practice shows that any success of terrorists provokes a further increase in terror and the number of victims).

In practice, this activity can be in the nature of cooperation in the development of a unified state

policy for the prevention of “environmental terrorism”, the rapid exchange of information between bodies in the field of ecology and environmental management, criminal justice, criminal prosecution of environmental terrorists and bringing them to justice.

5. *State risk management of environmental threats, “environmental terrorism”*. Transition to the system of analysis and risk management of “environmental terrorism”, in our opinion, should become a priority task in the activities of public organizations, the basis for ensuring a guaranteed level of security for a citizen, society, and the state. The main activities of public organizations in combating “environmental terrorism” are:

- participation in the formation of the regulatory framework for technological, natural and environmental safety on the basis of common risk management principles and its harmonization with the requirements of the European Union;

- participation in the introduction of human-induced, natural and environmental risks rationing, development of recommendations for the application of relevant standards in the mechanisms of state regulation of technological and natural safety;

- expanding the scope of research and development of methods, models, methods of analysis and risk assessment of emergency situations of man-made and natural nature, forecasting their development;

- development of a common technology for managing man-made, natural and environmental safety based on a risk-based approach;

- formation of recommendations for improving the monitoring system of hazardous technogenic objects and natural processes in the direction of providing an information base (for assessing the risks of environmental terrorism and emergency situations);

- development of scientific bases for the development of state programs for socio-economic development, taking into account the risk indicators of environmental terrorism, environmental accidents and disasters;

- participation in the introduction of new effective forms of analysis, assessment, examination and control of the safety of hazardous man-made objects at all stages of the life cycle;

- cooperation with international public organizations on the regulation of technological and natural security;

- making recommendations on improving the education system, providing training for specialists in the field

of man-made and natural emergency risk management.

6. *Prevention (systemic forecasting) of environmental terrorism*. Prevention is the primary and only way to prevent crime. Therefore, the priority in the fight against “environmental terrorism” belongs precisely to preventive activities. In its implementation, legislative, executive and judicial authorities, religious authorities, political party leaders, the media and the general public should find their place. It is necessary to consolidate various social trends in order to support the global strategy to counter “environmental terrorism” and extremism. It is necessary to create a multifunctional system of anti-terrorist actions. Such a system should include the optimal use of the intellectual potential of the nation, the human factor and their mobilization to solve the problems of combating environmental terrorism. This requires close interaction of all state and public structures to eliminate threats to the security of individuals, society and the state. Let us single out three levels of prevention of “environmental terrorism”: individual prevention (prevention of the commission of unlawful environmental actions by individuals or their groups); prevention of certain types of environmental crimes; prevention of environmental crime in general.

7. *The interaction of government and the public*. The civilized ratio of state and non-state systems should be the basis for the development and functioning of the entire national security system. It is this balanced architecture that provides the opportunity for harmonious development, as well as integration and large-scale implementation of the interests of the individual, society and the state.

Conclusions. When creating a methodology for countering environmental threats, risks and environmental terrorism, it is advisable to identify the systemic factors of “environmental terrorism”: biological, chemical, radiation, technological, natural, agricultural, etc. organizations to identify, identify and evaluate the synergistic effect of the manifestation of environmental factors and develop appropriate measures. These measures should be implemented in the following areas: improving the legislative framework; Information Support; cooperation with international organizations; system technologies to combat environmental terrorism; government risk management of environmental threats, environmental terrorism; prevention (systemic forecasting) of environmental terrorism; interaction of authorities and the public.

References

1. Биченок М.М., Трофімчук О.М. Проблеми природно-техногенної безпеки в Україні. К.: УІНЦіР, 2002. 179 с.
2. Білявський Г.О., Падун М.М., Фурдуй Р.С. Основи загальної екології. К.: «Либідь», 1993. С. 3–6.
3. Бондар О.І., Машков О.А., Абідов С.Т. Системний аналіз небезпеки у зоні проведення антитерористичної операції на сході України: біосферні конфлікти та транскордонне забруднення. *Екологічні науки: науково-практичний журнал*. К.: ДЕА, 2015. № 9. С. 5–26.
4. Верховна Рада України; Закон України «Про національну безпеку України» від 21 червня 2018 року № 2469-VIII.
5. Гошовський С.В., Рудько Г.І., Преснер Б.М.. Екологічна безпека техноприродних геосистем у зв'язку з катастрофічним розвитком геологічних процесів. К.: ЗАТ «НІЧЛАВА», 2002. 624 с.
6. Качинський А.Б., Хміль Т.А. Екологічна безпека України: аналіз, оцінка та державна політика. К.: НІСД, 1997. 127 с.
7. Качинський А.Б. Екологічна безпека України: системний аналіз перспектив покращення. К.: НІСД, 2001. 312 с.

8. Косевцев В.О., Бінько І.Ф. Національна безпека України: проблеми та шляхи реалізації пріоритетних національних інтересів. К.: НІСД, 1996. 61 с.
9. Машков О.А., Мамчур Ю.В. Загроза національній безпеці: екологічний тероризм як сучасний виклик суспільству. *Науковий часопис Академії національної безпеки*. 2018. № (17). С. 8–21.
10. Машков О.А., Мамчур Ю.В. Загроза національній безпеці: аерокосмічний тероризм як новий виклик безпеці суспільства. *Науковий часопис Академії національної безпеки*. 2018. № 1 (17). С. 8–28.
11. Настасенко О.Г., Бондар О.І., Машков О.А. Системний підхід щодо ліквідації екологічної катастрофи у зоні антитерористичної операції. *Екологічні науки: науково-практичний журнал*. К.: ДЕА, 2014. № 6. С. 5–20.
12. Національна доповідь про стан навколишнього природного середовища в Україні у 2015 році. К.: Міністерство екології та природних ресурсів України, ФОП Грінь Д.С., 2017. 308 с.
13. Указ Президента України Про рішення Ради національної безпеки і оборони України від 6 травня 2015 року «Про Стратегію національної безпеки України». URL: <http://zakon2.rada.gov.ua/laws/show/287/2015/para7#n7>.
14. Шмандій В.М. Управління екологічною безпекою на регіональному рівні (теоретичні та практичні аспекти): автореферат дис. ... д-ра техн. наук. Х., 2004. 36 с.
15. Шмандій В.М., Шмандій О.В. Екологічна безпека – одна з основних складових національної безпеки держави. *Екологічна безпека*. КрНУ. № 1/2008(1). С. 9–15.