FAUNA PROTECTION PRACTICES FOR UKRAINIAN MILITARY TRAINING AREA IN VIEW OF NATO GUIDANCE DOCUMENTS

Serhiy OREL

Hetman Petro Sahaidachny National Army Academy, Lviv, Ukraine

The objective of this article is an implementation of fauna environmental protection at one of the Ukrainian military training areas using the recommendations of NATO documents. The impact of military activities on territory of training area was evaluated by theirs influence on the two indicator species – listed in the Red Data Book of Ukraine – Lesser Spotted Eagle and White-tailed (sea)Eagle, included, in addition, to the European Red List too. The effect of heavy metals (lead, nickel, copper, zinc) that are accumulating in the soil of the training area on the ability to increase mass birds was investigated. It was found that the hazard index is significantly less than 1, which indicates satisfactory environmental conditions for the fauna of the territory.

Key words: *military training area, fauna protection, ecological risk assessment.*

1. INTRODUCTION

Ukrainian intention to be the member of European Union and NATO, which is fixed in its constitution, is reflected in the military sphere too. Recently Ukraine has adopted a number of NATO standards, including those related to environmental protection. These are: STANAG 7141 «Joint NATO Doctrine For Environmental Protection During NATO-Led Military Activities» (AJEPP-4), STANAG 2582 «Environmental Protection Best Practices and Standards for Military Camps in NATO Operations» (AJEPP-2), STANAG 2583 «Environmental Management System In NATO Operations» (AJEPP-3), STANAG 2510 «Joint NATO Waste Management Requirements During NATO-Led Military Activities» (AJEPP-5), STANAG 6500 «NATO Camp Environmental File During NATO-Led Operations» (AJEPP-6), STANAG 2594 «Best Environmental Protection Practices for Sustainability of Military Training Areas» (AJEPP-7).

The main document STANAG 7141 announces that "while meeting their military mission, NATO Forces should be committed to taking all reasonably achievable measures to protect the environment. To achieve this, commanders must know how NATO-led military activities affect and are affected by the environment. To implement this doctrine, NATO commanders should ensure environmental risk management is integrated into the overall planning for military activities. The risks associated with efforts to protect the environment should therefore be considered separately prior to, during and after military activities".

One of the important components of military activity is the troops training at the training areas. Training land is the "classroom" for soldiers where they are taught how to fight, survive and win a battle. Training lands have become scarce and additional training space is not available. We must keep training lands available for optimal use not only for us, but also for future generations. Another very important environmental support function is to provide training land for realistic and effective military training on a sustainable basis. This principle of sustained training land availability includes two environmental objectives: (1) protect natural habitats as legally required and (2) maintain healthy ecosystems as the prerequisite for realistic and natural training scenarios.

Another important aspect is that training areas have become very important retreat areas for threatened and endangered species. They are ecological islands surrounded by built-up areas and intensively used farm and forest lands. Training areas, therefore, provide homes for more flora and fauna species than hardly any other land in the densely populated and managed areas of central Europe.

Another NATO document STANAG 2594 is dedicated to best environmental protection practices for sustainability of military training areas. It also notes that "military areas are important to conservation because of their large size, intact microtopography (when compared to agricultural or urban areas), trophic situation (have seldom been used agriculturally, and poorer nutrient conditions encourage a larger variety of plants) and intact natural processes. Additionally, large portions of military training areas remain untouched, favoring disturbance-averse species; other portions are heavily disturbed, favoring disturbance-dependent species. The rich habitat mosaics include the two extremes as well as the continua of disturbance and succession between them, thus providing suitable habitat for a very

large number of species with widely varying habitat requirements".

At the same time military activities directly affect habitats include the following:

- Direct habitat loss, e.g. building and road construction;
- Introduction of alien, invasive species that out-compete native species;
- Reduction in habitat quality by discharging and emitting substances to air, land and water that affect the health of flora and fauna;
- Habitat fragmentation, whereby large areas are broken up by built developments, new transport routes or removal of hedgerow corridors;
- Dividing and confining populations to smaller areas may increase stress, make them less resilient to destruction and disease, and reduce the variety in the gene pool;
- Removal of elements that sustain an ecosystem.

Previously, we made an attempt to assess the influence of military activity on the environment at military training areas through the evaluation of environmental risk (Orel et al., 2018).

Now the objective of this article is the implementation of fauna environmental protection at one of the Ukrainian military training areas using the recommendations of NATO documents, which include environmental risk assessment.

2. ENVIRONMENTAL CHARACTERISTICS OF INTERNATIONAL PEACEKEEPING AND SECURITY CENTER (IPSC) IN VIEW OF STANAG 7141

IPSC is located in Lviv's region of Ukraine. Its mission is training the Armed Forces of Ukraine jointly with the other countries armed forces units. The applying of tanks, armored personnel carriers, infantry fighting vehicles is practiced on the territory for tactical training of troops. In addition, IPSC accommodates on its grounds signal training fields, artillery training grounds, missile and artillery units training areas and artillery shooting range (Orel et al., 2018).

According to STANAG 7141 "in order to effectively integrate environmental considerations for NATO-led military activities, commanders should identify the characteristics of the environment that may be impacted by or have an impact on NATO-led military activities:

- General environmental condition of the area;
- Climate;
- Water quality, including surface water and groundwater;
- Air quality;
- Natural and cultural resources;
- Presence of endangered species and critical habitats;

• Presence of birds or bird migration routes."

The territory of the IPSC belongs to the western endings of the Roztochchya ridge - one of the most interesting physics and geographical regions of Western Ukraine, which is the boundary area of the East European platform and the Carpathian Regional deflection. The territory of training areas are characterized by flat-topped hills up to 350 m above sea level, dissected by a river valley and the system of lakes formed after glacial formation. Most of the territory is occupied by forest and the rest of it - by a meadow-bog cenosis. The river Vereschitsa flows from south to north through the territory of the IPSC. In addition, there are 10 lakes, which feed on underground sources. The reservoirs form the flow of the Vereschitsa River and play an essential role in the formation of phyto- and zoocenosis.

The diversity of the plant and animal life of the IPSC is determined by the natural conditions of the Roztochya region, and primarily by its borderline location, which facilitates the exchange of floristic and faunal material with the region of Polissya and the Carpathians. The south-eastern part of the training areas adjoins the territory of the Yavoriv National Nature Park, which in its southern part borders the nature reserve " Roztochchya". Up to 700 species of vascular plants can be found on the territory IPSC. Vertebrate fauna IPSC constitutes today 24 species of fish, 11 species of amphibians, 6 species of reptiles, 199 species of birds and 46 species of mammals. 26 species of vertebrates identified in the Red Data Book of Ukraine including 1 species of reptiles, 18 birds and 7 mammals (Kuchinska et al., 2005).

Among the permanent species of birds listed in the Red Data Book of Ukraine, the following can be distinguished: Black Stork (Ciconia nigra), category II (vulnerable species, which in the near future may be classified as "fading away" if the effect of factors that affect their condition is not stopped); White-tailed (sea)Eagle (Haliaeetus albicilla L.), category II, included, in addition, to the European Red List; Lesser Spotted Eagle (Aquila pomarina C. L. Brehm), Category III (rare species whose populations are small and which at the moment do not belong to the categories of "disappearing" or "vulnerable", although they are endangered) (Parnikoza et al., 2005).

Among mammals there are: European Mink (M. lutreola L.), River Otter (Lutra Intra L.). All animals are classified in the second category of the Red Data Book of Ukraine, the river otter is also listed in the European Red List.

Conceptual model of military activities that affect especially rare animals is shown in Figure 1.

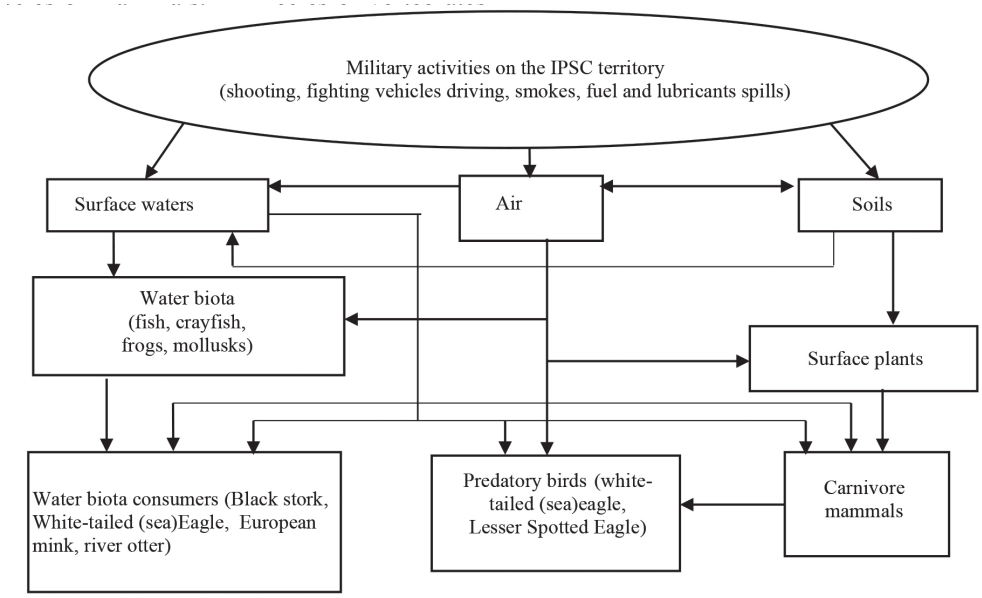

Fig. no. 1. Conceptual Model of the Impact of Military Activities on IPSC on the very rare representatives of the biota
Sources: (Orel et al., 2018).

In the course of military exercises, ferrous and nonferrous metals, chemicals used in smoke and imitation of fighting poisonous substances, lubricants and others pollute the environment. These substances are released into the air, water and soils and, directly or through food chains, end up in the bodies of animals that are objects of concern.

It should be noted that there is no systematic monitoring of the environment condition on the territory of the IPSC. Studies conducted in 1997 (Pidlisna, 1979), found that there is a certain degree of soil contamination by metals with little air pollution during exercises. The survey of the training territory conducted in 2009 (Manenko et al., 2009) and later studies showed that the degree of soil contamination remained at approximately the same level with some exceeding of the maximum concentrations of copper and nickel, pollution of water surface sources is within the limits of state norms, air pollution is absent. Therefore, further only environmental risk of polluted soils impacts on the biota was estimated. Concentration of contaminants into the soil of IPSC is given in Table 1.

Table 1 Concentration of contaminants into the soil of IPSC
Sources: (Manenko et al., 2009)

Concentration (dry weight)	Pollutants			
	Lead	Nickel	Copper	Zinc
Maximum concentration in soil, mg/kg of soil	35	850	64	40
Background concentration, mg/kg of soil	4.4	1.2	0.26	4.4
The sanitary standard of Ukraine, mg/kg of soil	6.0	4.0	3.0	23.0

It should be noted that animals which consume predominantly aqueous biota may be excluded from consideration due to the unpolluted water sources (with the exception of the White-tailed (sea)Eagle, which, in addition to fish, also consume avifauna and small mammals). Thus, the impact of military activities on IPSC territory on the environment will be evaluated by theirs impact on the two predators –indicator species – White-tailed (sea)Eagle and Lesser Spotted Eagle.

3 ENVIRONMENTAL RISK MANAGEMENT

Environmental risk management seeks to determine that environmental risks exist and then determine how to manage those risk in a way best suited to protect human health and the environment. Risk management is the action taken based on consideration of risk assessment which provides information on potential health or ecological risks (US EPA (a)). An ecological risk assessment is the process for evaluating how likely it is that the environment may be impacted as a result of exposure to one or more environmental stressors such as chemicals, land change, disease, invasive species and climate change.

An ecological risk assessment includes three phases (US EPA (b)):

Phase 1 - Problem Formulation.

Information is gathered to help determine what, in terms of plants and animals, is at risk and what needs to be protected.

Phase 2 - Analysis.

This is the determination of what plants and animals are exposed and to what degree they are exposed, and if that level of exposure is likely or not to cause harmful ecological effects.

The first two phases of ecological risk assessment for military activities on territory IPSC are reviewed above.

Phase 3 - Risk Characterization

Risk characterization includes two major components: risk estimation and risk description. "Risk estimation" combines exposure profiles and exposure effects. "Risk description" provides information important for interpreting the risk results and identifies a level for harmful effects on the fauna of concern.

The impact assessment of contaminants (stressors) on the fauna (receptor) of IPSC will be carried out by means of a deterministic assessment of the ecological risk by determining the so-called "hazard coefficient". This value is equals to the ratio of daily stressor dose that influences the receptor to the so-called "reference value of toxicity", that has the meaning of daily stressor dose which impacts the receptor throughout life and does not give rise to an unacceptable effect to it (Guidance (a)). For us it means ability to increase mass birds in the life process. That is,

$$HQ = AD / TRV, \quad (1)$$

where HQ – hazard coefficient;
AD – average dose, mg/kg;
TRV – the value of the reference value of toxicity in the corresponding dimension.

The ecological risk characteristics of harmful effects development under combined and complex action of stressors is conducted on the base of hazard index (HI) calculation. The hazard index for the conditions of simultaneous influence of several stressors is conducted in the same way (for example, by inhalation or oral) and is calculated by the equation

$$HI = \Sigma HQi. \quad (2)$$

For the rough estimation of risk by using HI, Table 2 can be used.

Table 2. Classification of risk levels
Sources: (Lu et al., 2003)

HI	Risk level
<1.0	Minimum - the desired (target) value of risk when carrying out environment preservation measures
1.0–10.0	Minor - acceptable for most biota subjects, but requires in-depth study of the sources and possible consequences of harmful effects to solve the issue of risk management measures
10.0–100.0	Significant - not acceptable for most subjects of biota, requires dynamic control and in-depth study of sources and possible consequences of harmful effects to solve the issue of risk management measures
>100.0	High - not acceptable for biota. It is necessary to implement measures to eliminate or reduce risk

It is obvious that pollutants can enter and accumulates into the birds' bodies only through the food consumption, as water sources and air are not contaminated. Consumption of water biota also does not bring hazardous substances into the diet of birds. The danger is having place only with consumption of creatures, which in turn consumed contaminated soil and plants that grew up on this soil.

The White-tailed (sea)Eagle's diet is composed of birds, fish and mammals. Prey composition depends from the hunt territory and constitute on average 51% of birds (mostly Anatidae), fish 42% and mammals only 7% (Nadjafzadeh et al., 2016) (Sulkava et al., 1997). In more arid territory diet is composed of 44% of birds, 28% of small mammals and 28% - fish (Zubarovskiy, 1977). The diet of Lesser Spotted Eagle is composed of mammalian species 88% (mostly Microtus arvalis), birds (mostly Galliformes) 6% and nearly 6% Amphibia, Reptilia and fishes (Dravecky et al., 2008).

Assuming that consumed birds are predominantly wild ducks (Anatidae) for White-tailed (sea) Eagle and partridge (Galliformes) for Lesser Spotted Eagle and mammals are field-mice (Microtus arvalis) for both predators, we can determine the intake of pollutants into the their bodies by the equation (4)

$$I = C_m \times IRf \times A_F \times AUF \times TUF/BW, \quad (4)$$

where I – pollutant intake, mg/(kg/day);

C_m – pollutant concentration in the meat of prey, mg/kg (dry mass);

IRf – consumption of food by predators, kg (dry mass)/day (normalized by body weight constitutes: for the eagle 0,12; for the snapper - 0,1 kg / (kg/day)) (US EPA Guidance 2018), (Methods and Tools);

AF – the share (by weight) of meat in general diet of predators, kg/kg (for the White-tailed (sea)Eagle 0,575, for the Lesser Spotted Eagle 0,72 (Zubarovskiy, 1977));

AUF – factor of the use of the area, hectare/hectare (in screening studies we assume AUF = 1, meaning that consumed prey is exclusively fed by contaminated food);

TUF – factor of time, days/days (we assume TUF = 0,5), as in the cold period of a year the White-tailed (sea)Eagle consumes different food, and the Lesser Spotted Eagle migrates to other regions, i.e., the consumption of contaminated food lasts for about 6 months;

BW – predators' body weight, kg.

Pollutant concentration in the prey meat (wild duck, partridge and field mouse) C_m, taking into account

direct prey soil consumption, determined by the equation

$$C_m = C_s \cdot UF_p \cdot UF_{ep} \cdot P_F + C_s \cdot UF_{es} \cdot S_F, \quad (5)$$

where C_s – pollutant concentration in soil, mg / kg;

UF_p – factor of pollutant bioaccumulation by plants from soil, kg / kg;

UF_{ep} – factor of pollutant bioaccumulation by meat of prey from the plant food, kg / kg;

P_F – share (by mass) of plant food consumption in the total ration of prey, kg / kg (0,98 (Methods));

UF_{es} – factor of pollutant bioaccumulation by prey from the soil, kg / kg;

S_F – share (by mass) of direct soil consumption in the general prey ration, kg / kg (0.02, (Methods));

Initial data for the calculation of pollutant intake to the predators bodies are given in Tab. 3. The values of *TRV* for them are also presented here (EPA 530–D–99–001C).

The results of the military activity impact on the IPSC fauna (in the form of the hazard index value *HI*) are presented in Tab. 4.

Table 3. Initial data for calculating the intake of pollutants into predators bodies
Sources: (Methods and Tools, EPA 530–D–99–001C)

Characteristic	Pollutants			
	Lead	Nickel	Copper	Zinc
Factor of pollutant bioaccumulation by plants from soil, UF_p, kg / kg	0.045	0.032	0.4	0.123
Factor of pollutant bioaccumulation by meat of prey from the plant food, UF_{ep}, kg/kg	1.56E-04	3.34E-03	2.42E-02	1.58E-03
Factor of pollutant bioaccumulation by prey from the soil, UF_{es}, kg/kg	1.50E-06	2.99E-05	4.14E-04	3.96E-05
Value of *TRV*, mg/(kg/day)	1.63	6.71	4.05	17.2

Table 4. The results of the military activity impact on the IPSC fauna
Sources: (author)

Objects of concern	Hazard coefficient *HQ*				Total *HI*
	Lead	Nickel	Copper	Zinc	
White-tailed bald eagle (Haliaeetus albicilla L.)	5.86E-06	5.76E-04	6.48E-03	1.92E-05	7.08E-03
Small snapper (Aquila pomarina C. L. Brehm)	3.90E-06	3.84E-04	4.31E-03	1.28E-05	4.71E-03

Comparing the results of the calculations with the acceptable risk values (Tab. 2) it can be noted that the risk for fauna is very little, despite the fact that the soil contamination exceeds sanitary standards of Ukraine. So, there is no need for additional measures to protect the environment, as there is no threat to life and well-being of biota.

4. CONCLUSIONS

The above article materials as well as experience from military territories of other countries (Jakimavičiūtė, I., 2004) shows that military training areas maintain a great biological diversity primarily because of specific military training activities, relative inaccessibility by the public as well as because fertilizers and pesticides are not used. Thus military utilization can be maintained in order to preserve rare natural objects unique to military training areas and rare in the countries of Europe. But the continued presence of rare fauna and flora in military training areas requires very well balanced and careful use of military land with proper conservation measures and regular observations and evaluations. The vital moment in nature management planning is continuity of this process. One-time management "injections" do not principally improve conditions for rare species and habitats. Regular applying of NATO guidance documents when planning exercises at military training sites will allow saving and increasing rare fauna on military areas.

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