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Tools and Approaches for Biodiversity Assessment within Oil and Gas Licensing Processes in Ukraine – a Review

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Abstract

In line with current legislation and Ukraine's international obligations, the assessment of the biotic environment is a key procedure in obtaining permits for oil and gas extraction. However, significant gaps remain in both methodological and regulatory frameworks. While the official guidelines for Environmental Impact Assessment (EIA) provide a general framework, they lack concrete research protocols for biotic components. This study offers a detailed set of methodological approaches to ensure comprehensive biodiversity assessment within EIA reports for oil and gas projects. The proposed framework is tailored to the technical specifications and spatial boundaries of planned activities, including construction sites, industrial platforms, wells, and sanitary protection zones. Field surveys are recommended prior to project initiation, during construction, and after commissioning. Standard research plots (25×25 m) are used for integrated studies of flora, fauna, and habitats, applying standardized methods such as bird counts, entomological sweeps, vegetation surveys, soil mesofauna sampling, and small mammal trapping. Additionally, transects are established within 300 m and 1000 m buffer zones to inventory flora, fauna, rare biota, , plant communities listed in Ukraine's Green Book and natural habitats of the Bern Convention. Invertebrates are assessed through soil traps, litter sieving, and targeted surveys of various microhabitats, while vertebrates are recorded through direct observation. Special attention is given to rare species included in the Red Data Book of Ukraine and Bern Convention appendices. The framework also integrates spatial analysis of the proximity of planned activities to protected areas, ecological networks, and the Emerald Network, thus strengthening the scientific basis of EIA in the oil and gas sector.

Keywords: Environmental Impact Assessment (EIA), natural habitats, protected areas, ecological networks, research methods, environmental legislation

1. INTRODUCTION

According to the Law of Ukraine "On Environmental Impact Assessment" (hereinafter – EIA), environmental impact assessment is defined as a procedure aimed at preventing environmental damage, ensuring ecological safety, protecting the environment, and promoting the rational use and reproduction of natural resources in the course of decision-making regarding economic activities that may have a significant impact on the environment, taking into account state, public, and private interests (Law, 2017). This Law, as well as the EIA procedure itself, is grounded in the Association Agreement between Ukraine, on the one hand, and the European Union (hereinafter – EU), the European Atomic Energy Community, and their Member States, on the other hand, which was ratified by the Parliament of Ukraine and has the status of law (Law, 2014). By this act, Ukraine, as a sovereign State, undertook the obligation to transpose a number of European legal instruments in the field of environmental protection, including the procedure of environmental impact assessment.

It should be emphasized that EIA procedure in the EU is governed by the harmonized Directive 2011/92/EU (hereinafter – the Directive) of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (Directive 2011). The Directive establishes a list of activities that may have a significant impact on the environment and are therefore subject to the EIA procedure. Such activities are systematized according to their criticality in Annexes I and II to the Directive. Annex I enumerates projects that are deemed to have a significant impact on the environment and are therefore always subject to EIA at the EU level. Annex II lists categories of activities that may potentially have a significant impact on the environment. However, it is the responsibility of each EU Member State to determine whether EIA is required for the activities listed in Annex II (Directive 2011). This determination depends on the parameters, location, and other characteristics of the proposed activity, as well as on threshold values (or criteria) for permissible or acceptable impacts established at the national level, or, alternatively, on a case-by-case assessment. In total, the Directive comprises six annexes, which, in addition to Annexes I and II, set forth the EIA screening criteria, the structure of the EIA report, the directives and decisions repealed by Directive (2011), as well as a comparative analysis with the 1985 Directive.

Ukrainian legislation provides for a mechanism of classification of types of economic activities according to the scale of their potential environmental impacts, which is largely analogous to the EU approach, with the distinction that permitting competences are regulated either at the national or at the regional (oblast) level (Law, 2017). In particular, Article 3 of the Law (2017) sets out two explicit lists (the first and the second categories) of planned activities and installations subject to mandatory EIA.

The first category of planned activities and installations, which are presumed to have a significant impact on the environment and therefore mandatorily require EIA, includes: oil and gas refineries; thermal power plants; facilities for the production and enrichment of nuclear fuel; metallurgy; asbestos production; chemical manufacturing; construction; waste management; exploitation of underground and surface waters; construction of dams and reservoirs; hydrocarbon extraction on the continental shelf; construction of pipelines; pulp production and processing; oil storage facilities; installations for carbon dioxide capture; wastewater treatment plants; poultry farming; construction of overhead power lines; as well as all clear-cutting and shelterwood logging (Law, 2017).

The second category of planned activities and installations, which may have a significant impact on the environment and are therefore also subject to EIA, encompasses: deep drilling; agriculture, forestry, and water management; extractive industry; energy sector activities; metal production and processing; mineral raw material processing; chemical industry; food industry; enterprises of the textile, leather, wood-processing and paper industries; infrastructure projects; other economic activities; tourism and recreation; and activities resulting in the discharge of pollutants into water bodies (Law, 2017).

It should be noted that, for the duration of martial law, a number of categories of planned activities are temporarily exempted from the EIA procedure. In particular, activities exclusively aimed at ensuring national defense, eliminating the consequences of emergencies, conducting recovery works to remedy the consequences of armed aggression against Ukraine during martial law, as well as activities related to the change of designated use of especially valuable lands and the placement of the National Military Memorial Cemetery, are not subject to EIA, provided they meet the criteria established by the Cabinet of Ministers of Ukraine (Law, 2017).

In addition to the Law (2017), which defines the scope of planned activities, the structure of the EIA report, and the decision-making procedure, Ukraine has enacted a series of subordinate regulatory acts that establish methodological approaches to the preparation of EIA reports (Order

2020, 2021, 2023). At present, however, there is no single or unified methodology for compiling reports, nor for determining the scope and accuracy of EIA research. The approved methodological guidelines are of a purely recommendatory nature and outline only in general terms the desirable parameters to be included in EIA reports. This, in turn, leaves broad discretion for developers in the choice of field and laboratory methods, the results of which may, under certain conditions, be misinterpreted. Consequently, such results for the same type of planned activity may prove non-comparable and, in some cases, may constitute grounds for refusal to issue permitting documentation. The absence of a standardized methodology for conducting field and laboratory studies thus becomes a source of subjective interpretation by decision-makers, which may also create opportunities for misuse and corruption.

The objective of the present review study is to identify appropriate methodologies for assessing the condition of the biotic environment in the context of implementing planned oil and gas extraction activities. In this regard, we consider the key components of the biotic environment, including flora, vegetation, fauna, rare species, communities and habitats, as well as the objects of the Nature Reserve Fund (hereinafter – NRF) and ecological networks, all of which may be subject to potential adverse impacts resulting from in situ oil and gas extraction activities.

2. Analysis of Methodological Recommendations.

The Methodological Recommendations for the Preparation of EIA Reports for Activities in the Field of Mineral Extraction approved by the Ministry of Environmental Protection and Natural Resources (Order 2021) constitute the basis for the development of EIA reports. The drafting and entry into force of this advisory document required four years from the adoption of the Law (2017). Its appearance marked an important step toward the unification of EIA report preparation. The Methodological Recommendations fully reflect the structure of the EIA report as prescribed by the Law (2017), including the key stages of research:

1. Description of the current state of the biotic environment and its probable change in the absence of planned activities. This "baseline scenario" requires assessment of such indicators as: (a) the presence of natural areas and sites under special protection both within the planned activity site and in adjacent territories, including the sanitary protection zone; (b) the presence of natural and semi-natural ecosystems (areas), as well as the state of biodiversity conservation within them; (c) the occurrence of rare flora and fauna species subject to protection, or the presence of animal migration routes; (d) the condition of natural and semi-natural ecosystems, as well as agro-landscapes, their resilience to potential pollution or other accidents, and their capacity for subsequent recovery.

2. Description of environmental factors likely to be affected by the planned activity and its alternatives. This section proposes assessing the degree of impact of the planned activity and its alternatives on: (a) potential losses of rare species of flora and fauna, their abundance, population size, and habitats; (b) potential losses of rare plant communities protected under the Green Book of Ukraine; (c) potential losses of rare habitats protected under the Bern Convention; (d) potential losses of forest and wetland communities; (e) potential losses of protective and green plantings; (f) potential losses of animal migration routes.

3. Description and assessment of the possible environmental impacts of the planned activity, in particular their magnitude and scale. This section of the Methodology contains rather vague and ambiguous formulations, often overlapping with the previous section, making it difficult to clearly distinguish or avoid duplication. Despite these shortcomings, several key aspects can be identified which should be reflected in an EIA report, including: (a) probable consequences of the planned activity for biodiversity; (b) predictive quantitative indicators of the intensity of probable negative impacts on biodiversity; (c) probable risks of pollution of adjacent territories and their effects on biodiversity; (d) the likelihood of recovery of natural ecosystems.

It should be noted that the latter two points duplicate earlier sections of the Methodology, thus generating confusion and uncertainty.

The Methodology also includes Chapter 10, which directly addresses biodiversity impact assessment. This annex is structured into three principal components: the types of impact (direct or indirect), the objects of study (plants, animals, communities, etc.), and general methodological recommendations.

It must be stressed that the Methodology does not contain specific definitions of research methods for the assessment of individual components of the biotic environment; rather, it only identifies the objects that must be examined. In practice, it is envisaged that the business entity – as the client – independently forms a research group at its own expense, while individual researchers independently select the methods for assessing both the current state of the biotic environment and the forecasting of probable changes (or their absence) as a result of the planned activity.

This situation highlights a pressing problem: the lack of integration and standardization of methodologies for assessing the biotic environment in order to produce a maximally comprehensive, high-quality, and reliable EIA report in the oil and gas extraction sector.

3. Typical Planned Activity for In Situ Oil and Gas Extraction

Preparatory works for well construction include earthworks (excavation and movement of soil), leveling of the site area, installation of drainage systems, laying of technological and utility pipelines with thermal insulation, and installation of fire hydrants (Fig. 1).

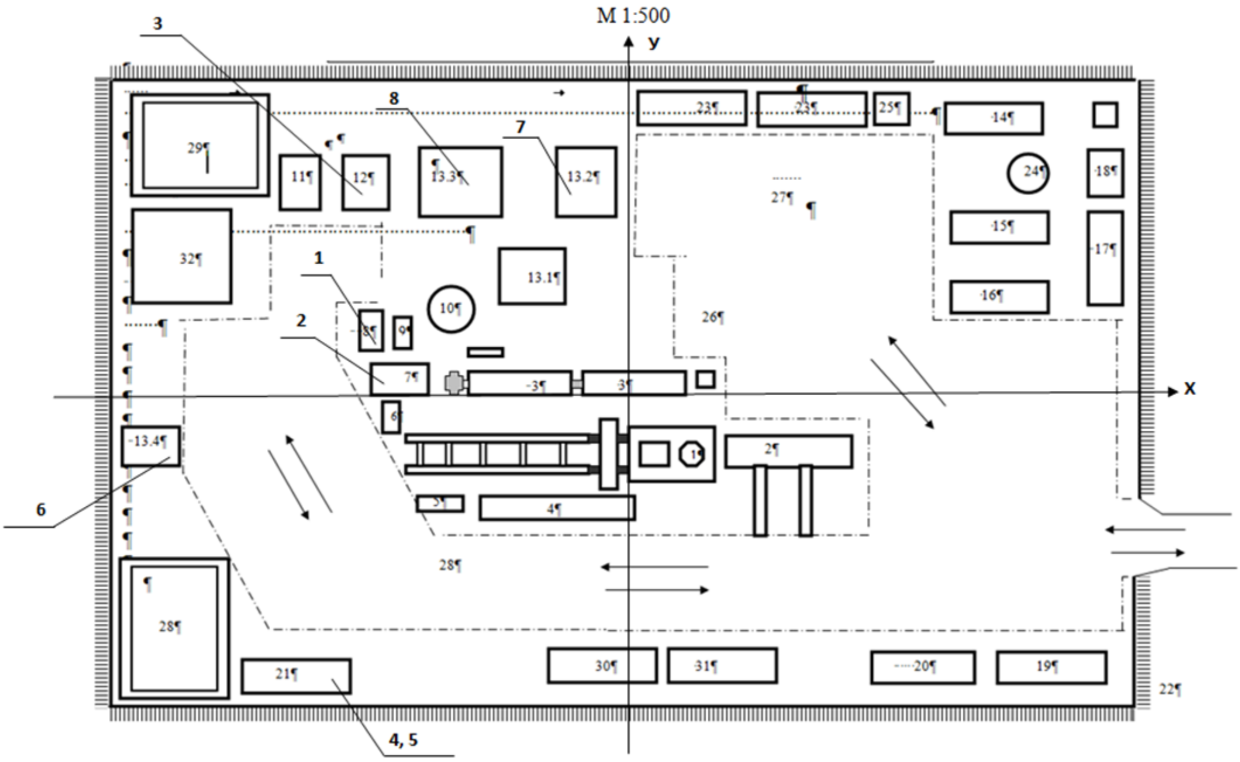

Fig. 1. Layout plan for exploratory well construction. 1. Rotary table; 2. Central receiving bridge with side racks; 3. Mud pit I, Mud pit II; 4. Hydraulic track; 5. Hydraulic drive; 6. Hydraulic clay mixer; 7. Pump; 8. Internal combustion engine (ICE); 9. Compressor; 10. Water tank; 11. Central switchgear; 12. Diesel power station; 13.1. Tank for spent drilling fluid; 13.2. Tank for drilled cuttings; 13.3. Tank for drilling wastewater; 13.4. Flare pit; 14. Residential trailer-house; 15. Canteen; 16. Supervisor's office trailer; 17. Food storage; 18. Shower unit; 19. Workshop; 20. Storage facility; 21. Diesel fuel tank; 22. Well cellar bunding (earth berm around well); 23. Fire-fighting water tanks; 24. Potable water tank; 25. Fire shield with sand container; 26. Pad for technological transport; 27. Pad for maneuvering of fire-fighting equipment; 28. Stockpile of mineral soil; 29. Stockpile of fertile topsoil; 30. Mud tank; 31. Mud tank; 32. Materials storage area; 33. Toilet.

To protect the allocated land from contamination, removal of the topsoil layer to a depth of 0.15 m by bulldozer is envisaged. The project does not provide for stripping of the fertile soil layer at the places designated for its storage. The removed topsoil is stored in stockpiles (heaps) with a height of 3 m and a slope angle of 30°. Mixing of the fertile soil layer with mineral soil is not permitted. Storage sites for the removed topsoil must be chosen on elevated areas without waterlogging and with no risk of flooding by floodwaters or storm surges. Stripping of the fertile soil layer is allowed only within areas of the allocated land that may be contaminated by petroleum products or other chemical substances that degrade its agrochemical properties.

To protect the stockpiles of removed soil from stagnation and flooding by floodwaters, the project provides for the construction of a drainage ditch 0.2 m deep along the perimeter of the drilling pad designated for well construction. This drainage system prevents waterlogging of the site from external sources.

In order to prevent flooding of the drilling pad by rainwater or meltwater, and to avoid the spread of formation fluids, technical water, or drilling mud across the technological site, a separate drainage system must be constructed. Additionally, for the purpose of lowering and diverting groundwater (perched water), two trenches are planned, each 50 m long, 1–1.5 m wide, and up to 3 m deep.

Drainage ditches with a depth of 0.2–0.3 m are to be arranged:

-along the inner perimeter of the entire site;

-beneath the drilling rig;

-around the storage area for fuels, lubricants, and chemical reagents;

-around the tanks and the unit for drilling mud preparation.

Earthworks and site clearance activities are to be carried out during the warm season. The preparatory and construction works include the excavation and movement of 2365.9 t of soil, delivery of 780.0 t of gravel for the foundation of the drilling rig, and 513.0 t of soil for embankment construction.

The technology of well construction involves rotary drilling to the depth of the projected horizon (1000 m) using a P-80 drilling rig. The well design is developed in accordance with current regulatory documents, taking into account the mining and geological conditions of drilling in this area, economic considerations, environmental protection requirements, and the applicable well construction technologies.

The number of casing strings and their setting depths are determined based on the requirements for successful penetration of the horizons that constitute the geological section, as well as the need to protect mineral resources and the environment under existing technologies.

A conductor casing with a diameter of 324 mm is set to a depth of 30 m in order to establish circulation, prevent erosion of the wellhead, seal off unstable Quaternary deposits, and isolate groundwater to protect it from contamination by drilling fluid filtrate during drilling operations for the surface casing.

A surface casing string with a diameter of 245 mm is set to a depth of 150 m to seal off the upper aquifers and protect them from contamination by drilling fluid filtrate during drilling for the intermediate casing. The wellhead is equipped with blowout prevention equipment (BOP) to mitigate gas kicks during penetration of deeper productive horizons in the course of drilling to the depth required for the production casing (diameter 146 mm). This casing string is cemented up to the wellhead using cement slurry.

The production casing with a diameter of 146 mm is set to a depth of 1000 m in order to seal off, test, and subsequently exploit the productive horizons, and it is also equipped with blowout prevention equipment.

4. Defining the Boundaries of Planned Activities and Potential Impacts on the Biotic Environment

The future location of wells and associated infrastructure, the boundaries of construction sites, the boundaries of industrial platforms for planned production wells, as well as the boundaries of sanitary protection zones of the planned activity are determined by the technical assignment formulated by the project designer and geological survey. Typical dimensions of a drilling site and its auxiliary infrastructure range from 0.7 to 1.5 ha, where earthworks, construction, and drilling operations will be carried out. Around the construction site, a standard sanitary protection zone with a radius of 300 m is established, although in some cases this may vary, reaching up to 1000 m.

The boundaries of the planned activity, identified in situ, including the construction site and the sanitary protection zone, are subject to baseline surveys to assess potential impacts on the biotic environment. Such surveys are conducted prior to the initiation of planned activities to document the current environmental state. These investigations must be repeated during preparatory and construction phases, and, following the commissioning of the well, carried out regularly in accordance with post-project monitoring requirements.

Within the territory of the future construction site, one or several (2-3) research plots are established, depending on the area of the site as well as representativeness in relation to phytocoenosis and relief. In homogeneous conditions and at small construction sites (0.6-0.8 ha), a single research plot is sufficient. If the terrain is heterogeneous, includes diverse phytocoenoses, or the construction site exceeds 1 ha, more plots are required; their number in each specific case is determined individually. The principal criterion is the diversity of conditions at the planned activity site. A standard research plot of 25×25 m should fully encompass a characteristic phytocoenosis and must not be located within an ecotone between two different plant communities (in such cases, two or more plots are required). Within each plot, the following sequential investigations are performed: bird counts, sampling of grass-dwelling and shrub-dwelling invertebrates using an entomological net, followed by floristic and geobotanical surveys, and finally the installation of temporary collectors for soil-dwelling mesofauna and traps for small mammals, reptiles, and amphibians.

Within the 300-meter sanitary protection zone around the future well, the research transect is established along which surveys are conducted of flora, fauna, rare biota, plant communities, and habitats subject to protection under current legislation of Ukraine. A similar transect is laid within the outer 1000-meter zone around the future well, with the same objectives as in the 300-meter zone. The transect should encompass the maximum number of biotopes and relief forms, with all observed species recorded by photography (with mandatory georeferencing) or entered into a field journal.

An interesting method increasingly applied in many EU countries for detailed biotic inventories is metabarcoding, which enables the compilation of a more comprehensive species list from environmental DNA traces. However, this technology remains underdeveloped and costly in Ukraine; therefore, classical floristic, geobotanical, zoological, zoosociological, and ecosystem research methods are typically employed. These will be the focus of our approach.

5. Methods for Assessing Flora, Plant Communities, and Natural Habitats

Floristic inventory within the study plots in the area of the proposed activity is carried out using the methods of parallel transects, diagonals, and parallel adjacency.

The parallel transects method is applied to survey meadows and forests and is also well suited for individual research plots. Its essence lies in establishing short transects along parallel lines, spaced 5 m apart, since the standard plot size is 25×25 m. This approach ensures comprehensive floristic and geobotanical descriptions, accounting for the mosaic nature of vegetation cover.

The diagonal method is suitable for small territorial units and provides robust results for the study of flora and vegetation on standard plots. The survey consists of traversing the plot perimeter and laying out conditional diagonals crossing its center. Both methods yield highly similar outcomes and are used interchangeably. However, the diagonal method is somewhat less time-consuming, especially where the habitat is relatively homogeneous, whereas the parallel transects method is more effective in heterogeneous and mosaic habitat, enabling a more exhaustive inventory of flora and plant communities.

If water bodies or rocky outcrops are present within the area of proposed activity, the parallel adjacency method is recommended, whereby survey transects are laid parallel to the above-mentioned features. In such cases, this method is best combined with parallel transects.

The research transect within the sanitary-protective zone should be designed to maximize completeness and objectivity of floristic inventory. At the reconnaissance stage, relief features, presence of water bodies, floodplains and terraces, and main vegetation types are identified. Subsequently, the transect is planned according to these criteria. Each biotope present within the territory must be surveyed in detail, with vegetation descriptions and compilation of a floristic conspectus.

Alongside floristic surveys, geobotanical descriptions of vegetation are conducted. For each plant species detected within a research plot, its abundance is estimated using the Braun-Blanquet cover-abundance scale, assigning the following scores:

5 – species covers more than ¾ of the plot (>75%);
4 – species covers from ½ to ¾ of the plot (50–75%);
3 – species covers from ¼ to ½ of the plot (25–50%);
2 – species covers from 1/20 to ¼ of the plot (5–25%), or sparse but exceeding 1/20 coverage;
1 – numerous individuals, covering less than 1/20 (1–5%);
+ – sparse individuals with negligible cover (<1%);
r – extremely few individuals (1–5 plants, <1%).

These data are recorded in the field journal or documented using a voice recorder, with additional photographic documentation of vegetation cover.

Vegetation classification is conducted at the desk stage using a scheme convenient for the researcher. Typically, the dominant classification or the Braun-Blanquet classification is applied. The former, though less precise, is easy to apply, time-efficient, and accessible to a wide range of researchers. The latter is more time-consuming and requires numerous geobotanical descriptions, but offers higher accuracy. Application of the Braun-Blanquet approach demands considerable expertise and specialized software, limiting its accessibility. Practice shows that the choice of classification method does not affect the likelihood of obtaining positive EIA conclusions in the oil and gas sector. Moreover, the official Methodology (Order 2021c) does not prescribe which classification system must be used.

Concurrently with geobotanical descriptions, identification of rare plant communities listed in the Green Book of Ukraine (Order 2020) and rare natural habitats (Revised… 1996; Explanatory … 2017; National… 2018) is carried out. Their identification relies on indicator species and the geobotanical descriptions described above. If several rare communities or habitats are present, they should be listed in order of decreasing representation. For each biotope, the proportion of the surveyed plot area it occupies should be indicated within the range of 1-100% (Environmental … 2021). The overall quality of each community or habitat should also be assessed. This is typically done visually, considering disturbances caused by human activity, natural processes, and invasive species, using a simple scale (excellent, good, moderate, poor, very poor). Similarly, the future prospects of the community or habitat are evaluated on the same scale, although in some cases such assessment may be impossible due to excessive uncertainty. All such communities and habitats should be documented photographically and illustrated in the EIA report.

6. Methods for Assessing Fauna

In terms of species richness, fauna greatly exceeds flora and all other biotic groups combined. While the number of chordate species is relatively small, the diversity of so-called “invertebrates” (a non-taxonomic and artificial grouping) is extremely high, ranging from several hundred to several thousand, or even tens of thousands of species, depending on the natural zone and biotope type. For example, agrocenoses are relatively poor in fauna, whereas meadow steppes are exceptionally rich.

Faunal surveys are highly dependent on seasonality, especially with respect to invertebrate animals. Many taxa are detectable and identifiable only during the adult stage, which often lasts for a very short period—ranging from a few days to several weeks. The seasonal turnover of faunal assemblages typically occurs every three weeks on average, and in southern regions of Ukraine, even more frequently.

Faunal dynamics are also strongly influenced by the altitudinal gradient. In mountainous environments, the emergence of imaginal stages may occur up to a month later compared to foothill conditions. In addition, annual weather conditions play a significant role. For instance, an early and warm spring may accelerate species emergence by 2–3 weeks, whereas a cold and rainy season may delay it by a similar margin.

Therefore, for maximum efficiency and representativeness of faunal inventories, it is recommended to incorporate latitudinal, altitudinal, and weather-related factors into survey design (Table 1).

Table 1. Seasonal shifts in invertebrate biodiversity levels depending on latitude and altitude within Ukraine

Latitude, deg.	Decade from the year begining																				
	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
44																					
46																					
48																					
50																					
52																					
Altitude, м	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
250																					
500																					
750																					
800																					
1050																					
1300																					
1550																					
1800																					
2050																					

Biodiversity: Low level Medium level High level

Invertebrate surveys are carried out using standardized methodologies: (1) pitfall traps for soil-dwellers; (2) litter and moss sifting for litter-dwellers; (3) sweep-netting of grass stands for grass-dwellers; (4) sweep-netting of shrubs and forest edges for bush-dwellers; (5) inspection of trunks, stumps, and fallen logs for wood-dwellers; and (6) inspection of flowers for anthophilous species.

Pitfall traps may consist of plastic containers with a volume of 0.5-1.0 L, buried so that their upper edge is at or slightly below the soil surface. Functionally, pitfall traps act as passive gravitational collectors and are widely employed for monitoring soil-dwellers moving along the soil surface or litter and exhibiting positive geotaxis. Invertebrates fall into the trap upon encountering it by chance. This method yields reliable results for qualitative and quantitative assessments of soil–litter invertebrates on the study plot. A standard layout involves two lines with five traps each. These lines may be arranged in parallel, spaced 10–15 m apart, or intersecting across the center of the study plot. The distance between adjacent traps should be 5 m. For smaller plots, an effective arrangement is the envelope method: five traps, four placed at the corners of a 10 × 10 m square and one in the center. To extend exposure, various fixatives may be used, including formaldehyde, sodium chloride, sodium tetraborate, glycerin, etc. Samples should be collected at intervals compatible with the preservative used, but no less frequently than once every 30 days.

Collection of litter-dwelling invertebrates from forest litter, moss, rotten wood, plant debris, fungi, or soil layers is carried out by sifting the substrate through portable soil sieves of various mesh sizes. Sifting is typically done onto a light fabric, and invertebrates are collected using an aspirator. Alternatively, sifted material may be sealed and processed in the laboratory using Berlese–Tullgren funnels or other extractor designs. During litter monitoring, the substrate should be returned and evenly redistributed across the sampling site after sieving.

Sweep-netting of grass-dwellers and bush-dwellers is performed by laying out parallel transects 25 m in length across the study plot. Along these lines, systematic sweeps are carried out with an entomological net, ensuring that the net frame follows a figure-eight trajectory through the vegetation. After a series of sweeps, the net is held vertically with a slight tilt, or with the bag opening directed downward, allowing it to collapse onto the frame and preventing insects and other arthropods from escaping. Captured specimens are collected with an aspirator or transferred into vials.

Manual collection and visual observation are employed in the inventory of invertebrates inhabiting arboreal microhabitats, tree trunks and branches, plant inflorescences, as well as for documenting animal behavior. During visual surveys, invertebrates are photographed, and data on species identity, abundance, and behavior are recorded in a field journal or dictated using a voice recorder. The method of visual observation is particularly effective for taxonomic groups that are easily recognizable with the naked eye, and for the inventory of species listed in the Red Data Book of Ukraine and other conservation lists, which must not be removed from their natural habitats.

The inventory of terrestrial vertebrates follows standardized protocols, including: direct visual observation; live-trapping; registration of tracks and other signs of presence; acoustic monitoring.

The most widely used approach is visual censusing of amphibians, reptiles, mammals, and birds in their natural habitats, supplemented, when possible, by photographic documentation. For ground-dwelling animals (excluding bats and birds) with cryptic lifestyles, live-traps are applied and must be checked regularly to prevent mortality of captured individuals. After inspection, animals are released unharmed at the site of capture. Small mammals are typically trapped with Sherman live traps, while medium-sized species are captured with Tomahawk or Havahart traps of various sizes.

Signs of mammal presence are identified using specialized field guides and the Instruction on the Census of Game Animal Abundance (Order 1999; Palamarenko 2015). Additionally, camera traps are increasingly employed for registering mammals (Zheltukhin & Ogurtsov 2018).

Bat surveys include the inspection of potential roost trees with cavities, trunk fissures, peeling bark, or broken branches. Evidence of bat presence is determined by characteristic social calls, accumulations of guano at the base of trees, and scratches near cavity entrances. To determine species composition, bat detectors are used to record ultrasonic communication signals (Kyheröinen et al. 2019).

Bird censuses are conducted by combining acoustic detection and direct observation under favorable weather conditions, along transects following the methods of Hayne (1947) and Ravkin & Chelintsev (1990). Transects typically measure 1000–3000 m in length and 100 m in width. Repeated surveys (at least three per spring–summer season) are required to ensure reliability. All recorded species are documented in field journals; in addition, bird vocalizations may be recorded for subsequent laboratory analysis using specialized software. When conducting bird inventories within areas subject to planned human activity, special attention is given to identifying breeding species that may be adversely affected by project implementation. Evidence of breeding includes: direct discovery of nests (with eggs or chicks, or abandoned nests with dead broods), observation of dependent fledglings attended by adults, or adult birds carrying nesting material (in passerines also fecal sacs in the beak). Critical importance is placed on confirming reliable breeding records of rare and legally protected species, particularly large raptors, Black Stork (Ciconia nigra), and Common Crane (Grus grus).

7. Methods for Assessing Rare Species

The state of rare species listed in the Red Book of Ukraine (Order 2021a, b) and the appendices of the Bern Convention (Law… 1996; Official… 1996) is assessed not only within the research plots but across the entire planned activity area, including its sanitary-protective zone and adjacent natural and semi-natural ecosystems. Detection of the presence or absence of rare species relies on standard botanical and zoological survey methods, as described above. When such species are identified within these delineated areas, they are subject to population-level assessment.

For this purpose, classical, well-established methods of population biology are employed, applied separately for plants and animals due to substantial differences in their biological, ecological, and evolutionary traits. For rare plants, the boundaries and size of cenopopulations are determined, and parameters such as population density, age structure, vitality, buffer capacity, spatial distribution, and connectivity within metapopulations (when feasible) are assessed. It is essential to differentiate plant populations by reproductive type—sexual (generative) or vegetative—as this directly influences their persistence under conditions of planned activities.

Population assessments for rare animals also require differentiated approaches, primarily reflecting each species' position within trophic networks. Predators, for example, occupy terminal positions in these networks and naturally exhibit lower population densities compared to omnivorous or herbivorous species. Therefore, low abundance and population density of large predatory mammals and birds represent a natural state. Significant differences in the density and abundance of rare animal populations are additionally influenced by body size and life cycle duration; smaller species generally exhibit higher population densities than larger species. Moreover, the spatial extent of populations differs markedly: large species may occupy tens to thousands of hectares, whereas small species inhabit areas orders of magnitude smaller. Consequently, when assessing the potential impact of planned activities, it is critical to consider the proportionality of the activity area relative to the habitat extent of rare species populations and potential effects on their spatial dynamics.

Each rare species is documented through visual observations without removal from its natural habitat, identified in situ, and, whenever possible, confirmed with photographic evidence. Data are recorded in a field journal, noting the number of individuals observed and their precise locations.

8. Methods for Assessing Protected Areas and Ecological Networks in Ukraine

Although the Methodology (Order 2021) requires assessment of potential impacts on protected areas (PAs), no direct methods exist that allow for this to be conducted explicitly. Nevertheless, Ukrainian legislation directly prohibits or strictly limits economic activities within PAs (Law… 1992). For certain PAs, protective or buffer zones are established, in which economic activities are also restricted. In light of these provisions, a critical component of an EIA report is determining the distances from PAs to the planned activity area. These distances are recommended to be determined using Geographic Information System (GIS) tools (e.g., QGIS or other). Neither the planned activity area nor its sanitary-protective zones may be located within the boundaries of PAs.

Given that nationally significant PAs constitute key components of Ukraine's ecological network, and locally significant PAs may form part of connecting territories (Law, 2004), assessment of impacts on these PAs simultaneously serves as an assessment of impacts on the ecological network itself. The Law (2004) further defines ecological network objects to include areas and sites of the protected area system, water and forest resources, extensively used agricultural lands (pastures, hayfields), and others. Each ecological network object must be delineated with an approved passport and conservation regime (Law, 2004). The status of each object is determined according to the relevant regional or local ecological network scheme. Accordingly, potential impacts of planned activities must be assessed in the context of the approved ecological network scheme.

One component of the ecological network is the Emerald Network, consisting of areas of special conservation interest. Its creation was initiated by the Council of Europe under the Bern Convention through Recommendation No. 16 (1989) of the Standing Committee. Despite Ukraine's accession to the Bern Convention (Law, 1996), the Emerald Network currently has no legal status within Ukraine. The draft Law on Emerald Network Territories has been under revision since 2021. According to Chapter 6, Article 361, Section f, Ukraine and the EU cooperate in the field of "nature protection, including the conservation and protection of biological and landscape diversity (ecological networks)" (Law, 2014). Therefore, the Emerald Network is considered a component of Ukraine's Ecological Network, and the same legal provisions (Law, 2004) apply to both.

No officially approved methodology with legal status exists in Ukraine for assessing potential impacts on ecological networks, including the Emerald Network. A public initiative has developed a proposed methodology (Environmental… 2021), which upon analysis shows no substantive difference from the existing EIA methodology for mineral extraction (Order 2021). This is due to the Emerald Network in Ukraine being defined outside the legal framework. Furthermore, the legal status of species and habitats under the Bern Convention remains unresolved, as the relevant Law (1996) does not specify conservation parameters, and the Convention itself delegates these responsibilities to national governments. Although the Law (1996) ratifies the Bern Convention with Appendices I–IV, Resolutions 4 and 6 from 1996 and subsequent updates remain outside Ukraine's legal framework. Consequently, there remains considerable methodological uncertainty in assessing the impacts of planned activities on the Emerald Network.

To assess potential impacts on the Emerald Network, we propose using standard data forms for these sites, containing information on rare habitats and species listed in the Bern Convention (European… 2025), complemented by field surveys to verify the presence of species and habitats reported in these forms. This approach is necessary because the Emerald Network in Ukraine was designed by non-specialists and consists of contiguous areas extending tens to hundreds of kilometers, often including settlements, buildings, communal infrastructure (sewerage, landfills, gas pipelines, power substations), roads, industrial objects, private gardens, agricultural lands, and other artificial structures. Nevertheless, individual localities containing rare natural habitats and Bern Convention species are included within these areas.

The algorithm for assessing potential impacts on the Emerald Network is as follows:

- Define the boundaries of the Emerald Network site in the field and determine its spatial relationship to the planned activity (type of intersection or distance between the objects);
- Identify rare habitats according to EUNIS criteria (Revised, 1996);
- Identify rare species listed in the Bern Convention (Law, 1996);
- Determine potential temporary, permanent, cumulative, and accidental impacts on rare habitats and Bern Convention species.

CONCLUSION

In summary, an analysis of current legislation and Ukraine's international obligations demonstrates that assessment of the biotic environment constitutes a critical procedure for obtaining permitting documentation in the oil and gas extraction sector. Our review, however, has identified significant gaps in both methodological guidance and regulatory frameworks for conducting such assessments. To address these deficiencies, we propose the adoption of clear, well-defined scientific algorithms and standardized methods to ensure a comprehensive evaluation of the biotic environment during the preparation of Environmental Impact Assessment (EIA) reports. Implementation of these rigorous approaches will enhance the reliability and objectivity of biotic assessments, thereby supporting informed decision-making in the management of oil and gas development projects while ensuring compliance with national and international conservation requirements.

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Анотація. Відповідно до чинного законодавства та міжнародних зобов'язань України, оцінка біотичного середовища є ключовою процедурою для отримання дозволів на видобування нафти й газу. Проте у методичному та нормативно-правовому забезпеченні залишаються суттєві прогалини. Хоча офіційна Методика щодо проведення оцінки впливу на довкілля (ОВД) надає загальну рамку, проте вона не містять конкретних протоколів дослідження біотичних компонентів. У цьому дослідженні запропоновано деталізований набір методичних підходів для забезпечення всебічної оцінки біорізноманіття у звітах з ОВД для проєктів у галузі нафтогазового видобування. Запропонована схема враховує технічні особливості та просторові межі планованої діяльності, зокрема будівельні майданчики, промислові об'єкти, свердловини та санітарно-захисні зони. Польові обстеження рекомендується здійснювати до початку робіт, під час будівництва та після введення в експлуатацію. Для інтегрованих досліджень флори, фауни та оселищ використовуються стандартні дослідні ділянки розміром 25×25 м із застосуванням стандартизованих методів, таких як обліки птахів, ентомологічні відлови, геоботанічні описи, відбір мезофауни ґрунту та пастки для дрібних ссавців. Додатково у межах санітарно-захисних зон 300 м та 1000 м прокладаються трансекти для інвентаризації флори, фауни, раритетної біоти, рослинних угруповань, занесених до Зеленої книги України, та природних оселищ Бернської конвенції. Безхребетних обстежують за допомогою ґрунтових пасток, просіювання підстилки та цільових обстежень мікробіотопів, тоді як хребетних реєструють шляхом прямих спостережень. Особливу увагу приділено рідкісним видам, занесеним до Червоної книги України та додатків Бернської конвенції. Запропонована схема також інтегрує просторовий аналіз впливу планованої діяльності на об'єкти ПЗФ, екомережі та Смарагдової мережі, що підсилює наукове підґрунтя ОВД у нафтогазовому секторі.

Ключові слова: оцінка впливу на довкілля (ОВД), природні оселища, природоохоронні території, екологічні мережі, методи досліджень, екологічне законодавство