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Amber licensing and extraction in Ukrainian Polesia

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About

Marcin Górnicki holds a master's degree in Environmental Protection from the Faculty of Biology at the University of Warsaw. His academic journey has been deeply intertwined with environmental sciences, specifically focusing on climate change and freshwater ecosystems such as peatlands. During his undergraduate studies, he conducted extensive fieldwork to estimate the carbon content in peat, highlighting the importance of these ecosystems in carbon storage. His master's thesis further expanded on this by estimating the greenhouse gas balance in organic soils across Polish national parks using the GEST method, a technique developed in Greifswald.

Marcin's passion for environmental science was ignited by a family member, a university lecturer, who mentored him in chemistry during his final school years. This early influence has shaped his academic and professional pursuits, driving his interest in GIS software and its applications in environmental monitoring and conservation.

His work continues to focus on the crucial issues surrounding climate change and ecosystem preservation, with a particular interest in the sustainable management of natural resources. This report on amber licensing and extraction in Ukrainian Polesia is a testament to his dedication to understanding and mitigating the impacts of human activities on sensitive ecosystems.

Abstract

This working paper explores the dynamics of amber licensing and extraction in Ukrainian Polesia, a region known for its rich natural resources and ecological significance. The study provides a comprehensive analysis of the legal framework governing amber mining, the socio-economic impacts, and the environmental consequences of these activities. By examining data from the Prozzoro.Sale platform over a period of 4.5 years (April 2019 to November 2023), the paper identifies key trends in the issuance of mining concessions, their geographical distribution, and pricing strategies. The research highlights the significant increase in the number of amber mining permits following legislative changes in 2019, aimed at curbing illegal activities and increasing transparency. Additionally, the report discusses the implications of these regulatory reforms amid the ongoing conflict in Ukraine, noting a surge in resource exploitation. The findings underscore the urgent need for balancing economic interests with environmental conservation, particularly given the proximity of mining sites to protected areas. Moreover, the paper reveals that Poland, despite being a major player in the global amber market, does not extract amber domestically but processes raw materials primarily sourced from Ukraine and Russia. This dynamic underscores the interconnectedness of the amber trade between these countries and the critical need for sustainable practices. The study aims to inform policy decisions and foster sustainable practices in the amber mining sector, ultimately contributing to the protection of Ukraine's natural heritage and the well-being of its local communities.

Keywords: Amber mining, Licensing, Extraction, Ukrainian Polesia, Environmental impact, Socio-economic impact, Legislative reforms, Natural resource management, Sustainable practices, Prozzoro.Sale platform, Carbon storage, Peatlands, Climate change, Protected areas, Conservation, Poland, Illegal mining, Amber trade

Abbreviations

UNCG – Ukrainian Nature Conservation Group

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1. Introduction

1.1. Background

1.1.1. Polesie: A Blend of Lowlands

Polesie is a historical and geographical region in the south-western part of the Eastern European Plain, mainly situated within the present-day territories of Belarus and Ukraine, and partially in Poland and Russia. As described by Stanisław Kulczyński (1939), "Polesie is a wide, incredibly flat and even parallel depression" (p. 748). It covers a strip of lowland extending from the Bug River in the west to about 200 kilometres east of the Dnieper River (Figure 1). The designated region covers an area of about 186,000 square kilometres (Save Polesia 2020).

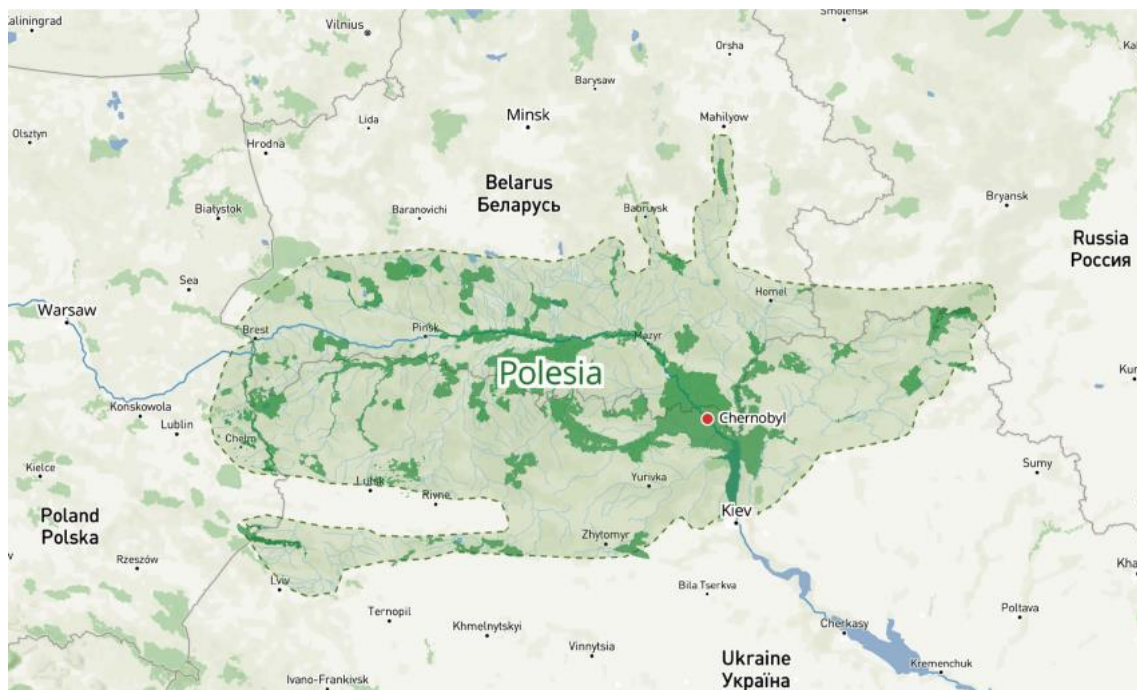


Figure 1. Polesie on the map along with internationally protected areas (dark green).

Resource: [\[link\]](#)

Despite the apparent abundance of water due to its mostly flat landscape, Polesie actually receives relatively little rainfall, around 500 to 600 millimetres per year. Berlin, for example, receives an average of 591 mm of rain per year. Polesie became marshy in the early Holocene, probably because the flat terrain made it difficult for the rivers, which were often low for much of the year, to cut deep channels into the ground. This often led to flooding during heavy rainfall. The combination of these conditions and shallow, impermeable layers led to the formation of peat in Polesie (Łotysz 2022).

1.1.2. Polesie: Europe's Threatened Wilderness

For a long time, swampy areas like Polesie were not considered beautiful or admired. People preferred landscapes with diverse features such as mountains and rivers. The challenge of defining natural boundaries between water areas in these swampy regions encouraged the construction of canals linking nearby rivers. Therefore, the first proposals to drain the Polesie were made at the end of the 18th century, when the area was under the rule of the Russian Empire, with the construction of the Royal Canal beginning in 1775 (Michalczyk et. al., 2002; Łotysz 2022).

Despite numerous attempts to drain the Polesie, most notably by the Soviet Union in the 1960s, which resulted in excessively deep ditches, the region still retains its distinctive features such as pristine forests and vast wetlands, cementing its status as Europe's largest remaining inland wetland wilderness. Polesie is home to a diverse range of wildlife, including endangered species such as the Aquatic Warbler, Greater Spotted Eagle and European Bison. It also serves as a vital habitat for hundreds of thousands of migratory birds that stop over to rest, feed, and breed each year (Labuschagne 2021).

As the largest natural wetland ecosystem in Central and Eastern Europe, Polesie also provides a wide range of ecosystem services. It helps manage water flows, purifies water, stores a large amount of carbon and supports a variety of plants

and animals. The wetlands, especially along the rivers, are essential for a wide variety of wildlife and support local communities. They also provide cultural services such as recreational opportunities, ecotourism infrastructure, aesthetic values and educational services (Yatsukhno 2012; Kun 2019).

Today, despite its significant natural value, the Polesie faces several contemporary threats to its natural landscape and ecosystem. The main issues are climate change, habitat fragmentation and drainage of wetlands. This is linked to increasing pressure from current land use for forestry, agriculture, infrastructure development, but also from unsustainable extraction of resources such as amber and peat, the intensity of which has increased over the last decade, especially in the Ukrainian part of Polesia (Piechal 2017).

1.1.3. Illegal Era of Amber Mining: Polesia's Devastation in Ukraine

Amber mining in Ukraine has a long history, with the gemstone being burned for a variety of reasons, including the extraction of amber oil for use in medicine. Over time, however, the practice of burning amber diminished as people became aware of its value as a precious natural resource. The beginning of industrial amber mining dates back to the 1990s, a period marked by ineffective efforts to formalise a legal amber mining system. As a result, illegal amber mining has gradually gained ground since the mid-1990s and intensified after the Revolution of Dignity. As of 2014, it is estimated that 90% of Ukrainian amber is extracted illegally, with the trade controlled by armed organised crime groups (Piechal 2017).

The Ukrainian part of Polesia was the main area of illegal amber mining. The main method of the sunstone extraction in that time was hydraulic mining, where water is injected into sandy sediments to bring the amber to the surface, creating pits. The miners then use a net to catch the stones as they rise and flow out of the holes (Photo 1). The landscape of an area affected by amber mining is often

compared to a moonscape, characterised by an irregular topography, with patches of barren or eroded land in the midst of natural surroundings (Tymoshchuk 2018).



Photo 1. Workers extracting amber using water using water to loosen the soil. The characteristic circular holes formed during mining can be seen.

Resource: [\[link\]](#)

Illegal amber mining in Polesie, especially in Volyn Oblast, Rivne Oblast, and Zhytomyr Oblast, has severely damaged the area. Extensive forest fires and logging have occurred, alongside draining many peatlands and polluting rivers. Many protected areas are in immediate danger. The absence of trees and vegetation has led to soil erosion, threatening the natural beauty of the region. This transformation due to mining activities has had a profound impact on the Polesie landscape and is one of the main threats today (Volhynia 2018; Wendle 2021).

1.1.4. Efforts Towards Regulating Amber Extraction in Ukraine

After many unsuccessful years in the fight against illegal amber mining in Ukraine, the Verkhovna Rada of Ukraine took a bold step towards the end of 2019 to fight against the actions of the amber mafia by adapting Law No. 402-IX (2019) on the Improvement of Legislation on the Mining of Amber and Other Minerals. One of the main motivations behind the Verkhovna Rada's decision was, and still is, the desire to meet the necessary criteria for accession to the European Union. As we can read in the Resolution on the implementation of the EU Association Agreement with Ukraine, 'the EU urges Ukraine to effectively combat illegal and environmentally damaging methods of amber extraction' (European Parliament, 2021).

The aforementioned law adopted by the Verkhovna Rada, introduced significant changes to the regulations governing amber mining. The law aimed to regulate the use of subsoil for amber mining, reduce illegal mining, improve living standards in mining areas, ensure environmental protection during mining and rehabilitate disturbed areas. To address various aspects, it introduced pre-auction land reservation, unified exploration permits for limited areas, and set the initial auction price for amber mining permits. The law also established strict penalties for illegal mining practices, including fines for uncertified equipment and criminal liability for failure to reclaim land.

Since the change in legislation in 2019, auctions for the extraction of amber, as well as other natural resources such as peat, have been held on the Prozorro.Sale platform - an electronic auction system designed for the transparent sale of state and local government assets. Each auction has its own subpage with information about the initial price, the exact location of the planned extraction, the type of concession, but also, if sold, access to the minutes with a list of participants with price bids and the final result. Access to the platform is free and open to the public.

1.1.5. Amber Extraction Surge in Ukraine: Implications Amid Conflict

More than a year after the introduction of amber mining regulations, there has been a Russian invasion of Ukraine. According to the Ukrainian Conservation Group (UNCG), the sale of licences to mine natural resources, including amber, has risen sharply since the outbreak of the conflict. There is also strong evidence that the Ukrainian state has often undercut prices to sell land at any price since the outbreak of war in 2022. Occasionally, licences are granted for gemstone mining near protected areas such as Rivne Nature Reserve.

Furthermore, the nature conservation sector in Ukraine is facing challenges arising from the ongoing conflict and war. The lack of qualified personnel has had a significant impact on institutional capacity, with many Ukrainian experts displaced and some leaving the country permanently. As a result, there's a notable lack of human resources in Ukraine capable of conducting comprehensive research into the legal amber market in recent years.

2. The purpose of this research

This study aims to provide a comprehensive analysis of the amber mining industry in Ukraine, with a focus on legally sold concessions. Key objectives include estimating the number and area of sold concessions, identifying key mining hotspots in Ukraine, but also analysing the evolution of auction prices over the years. The study also includes an analysis of peat mining concessions.

Given the shortage of human resources in Ukraine, exacerbated by a lack of experts and emigration, the research aims to fill the information gap related to amber mining in the region. The project aims to bring together available data to create a comprehensive narrative that sheds light on the multifaceted dynamics of amber mining.

It is hoped that the research findings will act as a catalyst to stimulate discussion and dialogue on potential strategies to improve the current situation. By laying this groundwork, the study aims to pave the way for informed interventions aimed at mitigating the negative impacts of amber mining in Ukraine.

3. Methods

3.1. Analysis of issued concessions in Ukraine

In order to analyze all legally issued concessions in Ukraine, a specific database was created. The data necessary to build the database were downloaded from the Prozzoro.Sale platform. The study period spanned 4.5 years, from April 2019 to November 2023, covering the territory of Ukraine where amber and peat are extracted. Initially, the study aimed to include all regions, but data for Volyn Oblast were unavailable, and thus, results for this region are not included.

The final study area comprised the following oblasts:

For amber concessions, the regions included were Rivne and Zhytomyr Oblasts. For peat concessions, the study covered Cherkasy, Ivano-Frankivsk, Kyiv, Lviv, Poltava, Rivne, Sumy, Ternopil, and Zhytomyr Oblasts.

For each auction examined, information was collected on the starting price, size of the area, location of the area, and the type and duration of the mining concession. If the auction ended with a sale, additional information such as the sale price, the amount of the highest bid (which was higher than the sale price), and details about the auction winner were also collected.

The data collected was organised and analysed using spreadsheet software, such as Excel, to provide a comprehensive assessment and insight. Only auctions that ended with a sale were considered for the calculations. Data was

compared chronologically from year to year in order to understand the dynamics of concession sales in Ukraine. To do this, the number and total area of concessions sold in each year were added up.

To estimate the average price of the amber mining sites, the prices of the concessions were added up and divided by the area they covered. Due to the high inflation in Ukraine in recent years, the sale price was converted from UAH to EUR using the monthly euro exchange rate (InforEuro 2023) for greater accuracy.

To determine whether all the concessions sold shared the same type of permit, they were compiled and compared annually. Additionally, to assess the distribution of sold concessions, they were categorised according to specific administrative units (e.g., oblast, community) and compared based on issued permits, total area sold, and average price per hectare.

3.2. Mapping of issued concessions in Ukraine

On the Prozzoro.Sale platform, the geographical coordinates for each auction were obtained in DMS format (degrees, minutes, seconds) and then converted to DD format (decimal degrees). Then, using GIS software such as QGIS, each concession described in the database was visualised as a polygon. The nearest protected area was identified from the location of the proposed amber/peat extraction and the distance to it was recorded in the database.

4. Results

4.1. Amber licensing

4.1.1. Number of sold amber concessions

In April 2019, the first amber mining concession in the study area was sold in Zhytomyr Oblast, the only concession granted that year (Table 1). Between 2019 and the end of 2023, 91 amber mining permits have been granted to private companies in the study area. In the first three years, there was a significant increase in the number of permits sold, with more than half of them (53) sold in 2021 alone. In the following years, on the other hand, the number of permits sold gradually decreased, reaching nine in 2023.

Year	Issued permits	Area [ha]	Price per ha [EUR/ha]
2019	1	19	1165
2020	10	807	2069
2021	53	1160	778
2022	18	601	923
2023	9	1334	698
In total	91	3922	Avg. 1041

Table 1. The table presents data on the number of amber permits sold, area and price per hectare of amber mining sites in Ukraine from 2019 to 2023.

4.1.2. Area of sold amber concessions

The total area of all amber concessions legally auctioned and sold in the study area was 3,922 hectares (Table 1). The total annual area of land sold for amber extraction in the study area has increased year on year since the beginning of 2019 (with the exception of 2022, when a decrease was observed), reaching its maximum outcome in 2023. The average size of land sold for amber mining was 43 hectares; nevertheless, about 80% of all permits were 9-10 hectares in size.

Notably, some of the largest sites, such as "Єльне" and "Єльне-1" exceeded 500 hectares (see Appendix 1).

4.1.3. Price per hectare of amber mining site

The average price per hectare for amber extraction in the study area in the years considered was 1,041 EUR, with the highest price being recorded in 2020 (2,069 EUR) and gradually decreasing over the following years to 698 EUR in 2023.

4.1.4. Duration of sold amber concessions

The concessions granted for the extraction of amber varied in the length of time for which the winning enterprise was granted the right to extract amber. In the vast majority of cases, concessions were granted for five years (Table 2). However, in 2023, for the first time, concessions were granted for longer periods, two of them for 10 years and one for 20 years.

Year	Permit duration [years]		
	5	10	20
2019	0	0	0
2020	10	0	0
2021	53	0	0
2022	18	0	0
2023	6	2	1

Table 2. The annual number and duration of amber permits from 2019 to 2023. Permits were issued for 5, 10 and 20 years.

4.1.5. Distribution of sold amber concessions in study area

Amber mining permits were identified in only two regions of Ukraine, with Rivne Oblast significantly predominant, accounting for almost 80% of all permits issued on its territory, while nineteen concessions were sold in Zhytomyr Oblast (Table 3). The distribution of permits for amber mining in Ukraine is visualised in Figure 2.

Oblast	Number of permits issued per year					
	2019	2020	2021	2022	2023	In total
Rivne	0	6	44	14	8	72
Zhytomyr	1	4	9	4	1	19

Table 3. Number of permits issued per year in each oblast of Ukraine.

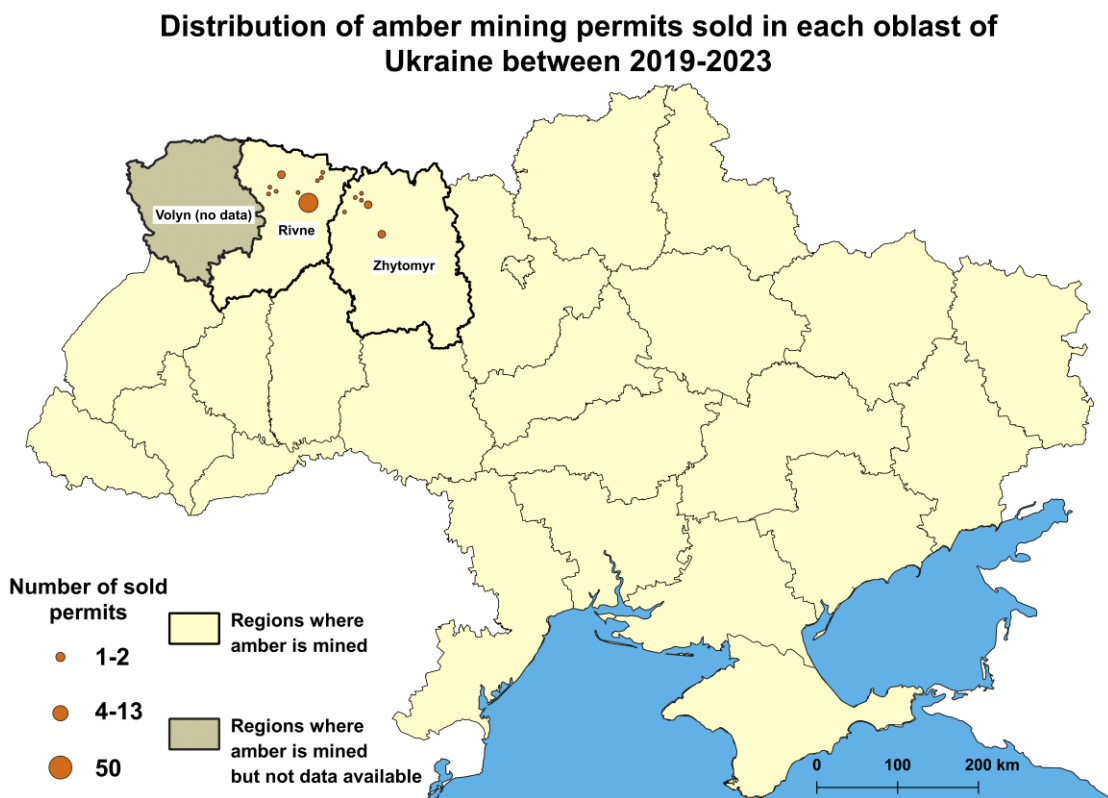


Figure 2. Distribution of amber mining permits sold in each oblast of Ukraine between 2019-2023. Amber mining is indicated in oblasts with bold borders. In the case of Volyn Oblast (shaded area) there was no publicly available data, so results for this region are not included.

4.1.6. Distribution of sold amber concessions in Rivne Oblast

As a significant number of the concessions sold are located in Rivne Oblast, it is worth analysing this area in more detail. The total area of the 72 concessions sold in Rivne amounted to 2835 ha, which is more than 70% of the total area of all concessions granted in Ukraine. All amber mining concessions sold in Rivne Oblast are concentrated in 8 communities in the northern part of the oblast, which is illustrated in Figure 3.

Permits for extraction of amber sold and their area in individual communities of the Rivne oblast

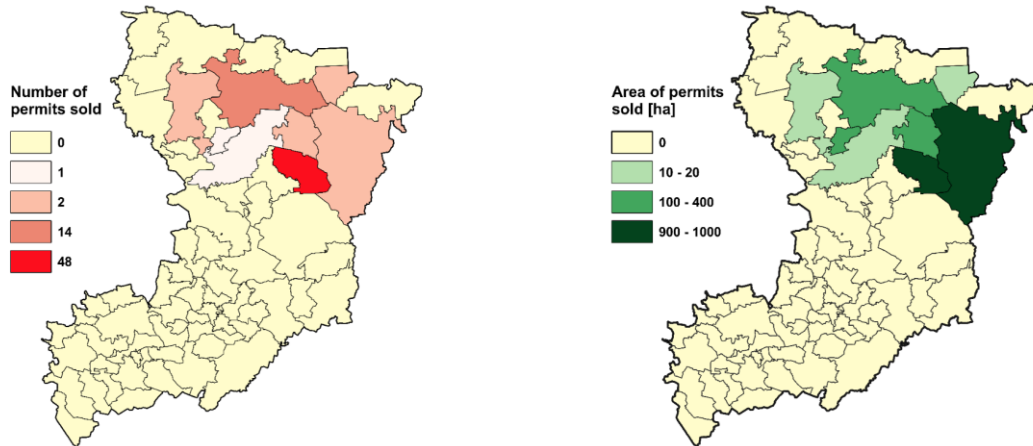


Figure 3. Administrative division of Rivne Oblast into communities. The intensity of the red colour indicates the number of concessions sold, and the green colour indicates the total area of concessions granted.

The communities of Rivne Oblast differ in the number and total area of the sold amber mining concessions. The highest number of sold concessions (48) was recorded in the Vyrivs'ka village territorial community (Вирівська сільська територіальна громада), where their total area of 914 ha was the second highest (Table 4). The largest amber mining area (1079 ha) was sold in Rokytisvka village territorial community (Рокитнівська сільська територіальна громада).

Community	Issued permits	Area [ha]	Price per ha [EUR/ha]
Антонівська	1	107	106
Володимирецька	2	20	2966
Вирівська	48	914	2716
Дубровицька	14	381	811
Клесівська	2	305	132
Рокитнівська	2	1079	332
Сарненська	1	10	958
Старосільська	2	19	585
In total	72	2835	Avg. 1076

Table 4. The number of sold concessions and their total area and the price per hectare of such an area in the individual communities of the Rivne Region in the period from 2019 to 2023.

4.1.7. Protected areas in Rivne Oblast affected by amber mining

More than 80% of the amber mining concessions sold were located within 5 kilometres of a protected area (Appendix 1). Most of the protected areas close to the amber extraction, represented the lowest forms of nature protection in Ukraine, the so-called 'Zakaznik'. This situation is well illustrated by the distribution of sold amber mining concessions and protected areas in Rivne Oblast (Figure 4).

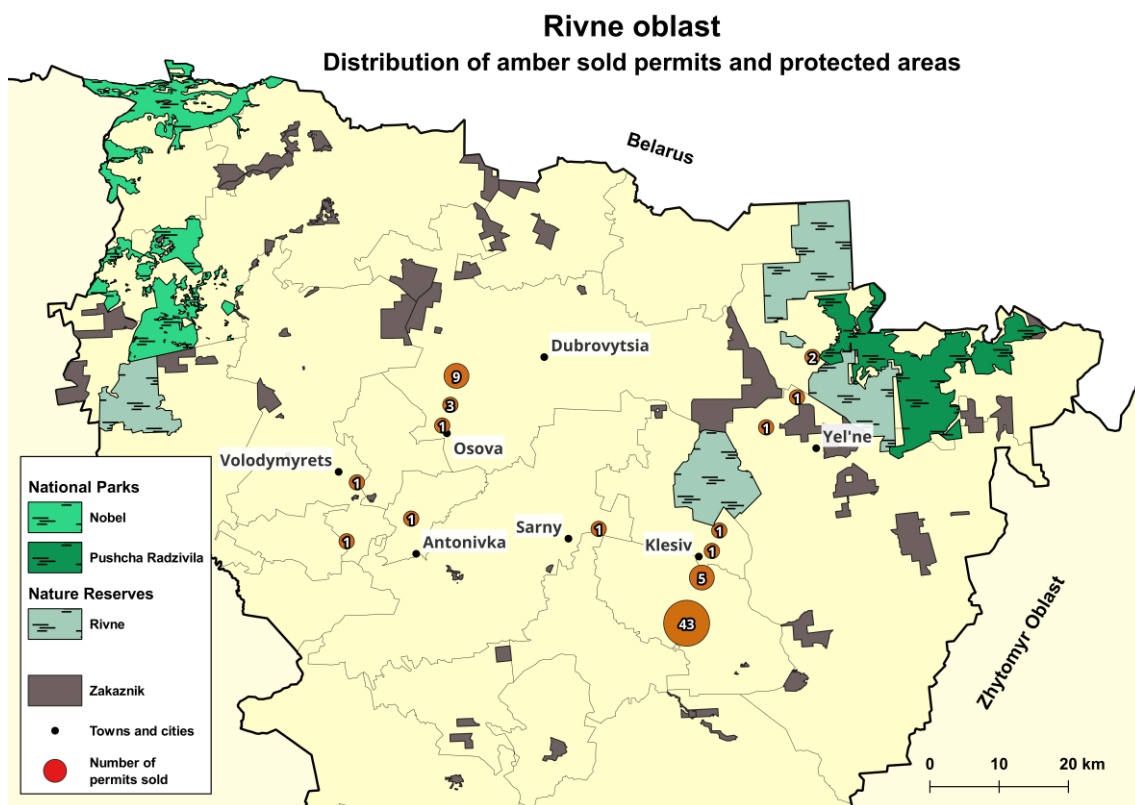


Figure 4. Distribution of amber sold permits and protected areas in Rivne Oblast. The size of the red circle corresponds to the number of amber mining concessions sold.

In Rivne Oblast, the sold concessions were located directly on the border with the nature reserve and the national park (Figure 5). This was respectively the Rivne Nature Reserve next to which three concessions have been sold; Ёльне (516 ha), Ёльне-1 (562 ha), Луки (295 ha) and also the Pushcha Radzivila National Park next to which two concessions have been sold; Вежиця-1 (9 ha) and Вежиця-2 (9 ha).

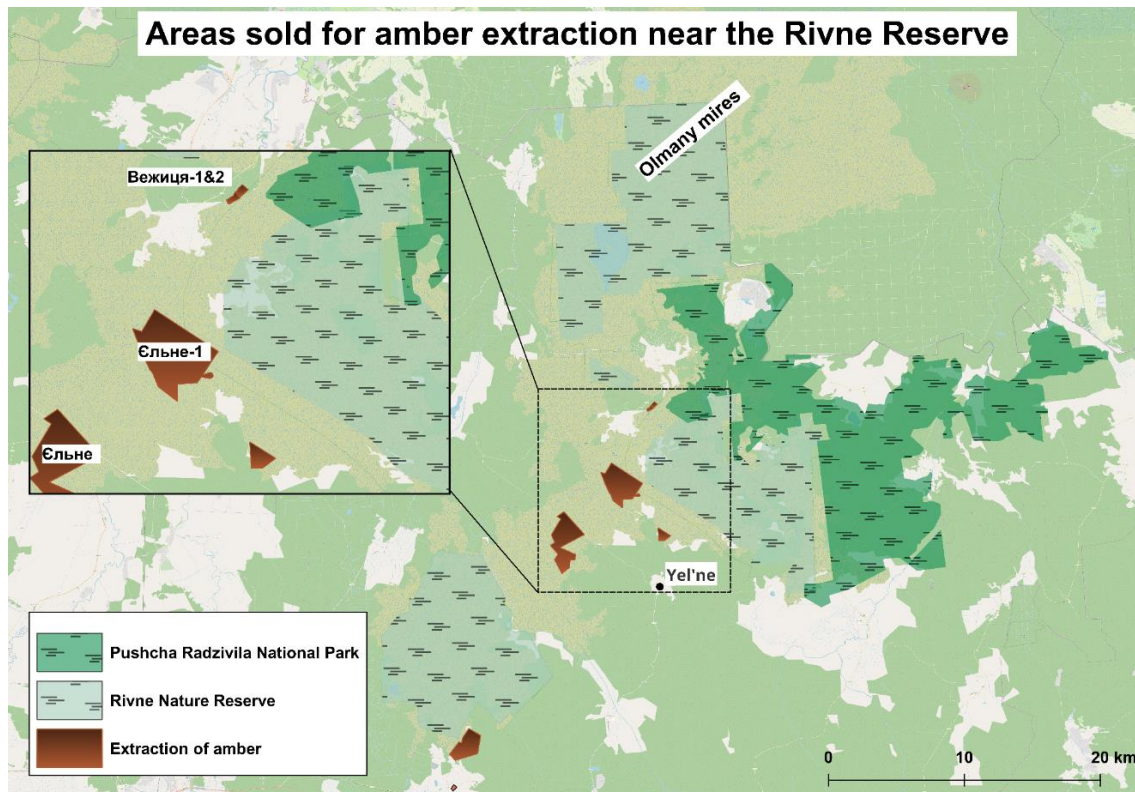


Figure 5. The map shows the location of the sold amber mining sites (brown colour) around the Rivne Nature Reserve in the Rivne Oblast.

4.2. Peat licensing

4.2.1. Number of sold peat concessions

The first peat concessions in study area were sold in 2021, and it was during this period that the most of all years were sold (Table 5). By the end of 2023, 20 concessions for amber mining had been sold to private companies so far.

Years	Issued permits	Area [ha]	Price per ha [EUR/ha]
2021	11	1394	254
2022	2	101	361
2023	7	2545	1352
In total	20	4040	Avg. 656

Table 5. The table presents data on the area, number of peat permits sold and price per hectare of peat mining sites in Ukraine from 2021 to 2023.

4.2.2. Area of sold peat concessions

The total area of peat mining concessions sold in Ukraine was 4040 ha, with the largest total area sold in 2023 (Table 5). The average area of the concession was 202 hectares, with the largest concession "Озерянського" in Ternopil Oblast covering an area of more than 1,600 hectares (Appendix 1).

4.2.3. Price per hectare of peat mining site

The average price per hectare of area for peat extraction in Ukraine in the years under review was EUR 656 (Table 5). It is noteworthy that this price increased year on year, reaching EUR 1352 per hectare in 2023.

4.2.4. Distribution of sold peat concessions in study area

It was shown that the distribution of sold peat mining concessions in the study area did not show a clear concentration in one region. In total, concessions were sold in nine regions, of which in some cases there was only one concession (for example, in Ivano-Frankivsk and Kyiv oblasts), while the highest number of concessions, as many as five, was recorded in Lviv oblast (Appendix 1).

4.2.5. Protected areas in Ukraine affected by peat mining

The distance between the peat extraction concession and the protected area was on average 3.8 kilometres. However, it is worth noting that there were both situations when the concession area was located directly on the border with the protected area, as in the case of the "Грузчанська" concession located next to the "Гідрологічний заказник місцевого значення Артюхівський", as well as at a distance of more than 15 kilometres in the concession "Карабачинська" (Appendix 1).

Other protected areas that may be endangered due to peat extraction in their vicinity are "Гідрологічний заказник загальнодержавного значення Чайковицький" in Lviv Oblast, "Гідрологічний заказник місцевого значення Урочище Верб" in Rivne Oblast, and "Національний природний парк

загальнодержавного значення Північне Поділля" in Ternopil Oblast (Appendix 1).

5. Discussion

5.1. Resource Extraction Dynamics in Ukraine

5.1.1. Amber Market Fluctuations and Regulatory Impact

The Ukrainian amber market has experienced significant fluctuations in recent years, potentially influenced by legislative changes and geopolitical events. The notable increase in the number of amber concessions granted in 2021, with 53 concessions issued, may be attributed to the legislative reforms introduced in 2019 aimed at regulating the amber market and mining industry. Furthermore, these reforms have provided unprecedented public access to data, allowing for the first comprehensive analysis of the market dynamics through the Prozorro platform, something that was not possible before the legislative changes.

However, this period of heightened activity was followed by a decline in both the number of concessions and their average price per hectare. Notably, while the price for agricultural land remained stable at around 1,017 EUR per hectare from 2021 to 2023, according to data from OpenDataBot (2024), the price of amber extraction sites experienced a marked decrease: from 1,041 EUR per hectare in 2021 to 923 EUR in 2022, and further down to 698 EUR in 2023. This divergence highlights differing market dynamics and investor confidence between these sectors, with the decreasing prices of amber land possibly indicating a drop in demand for amber or a strategic pricing adjustment to attract investors amid broader market challenges.

The total area covered by amber concessions in a study areas illustrates this strategic shift, with a significant increase in 2023 despite a smaller number of concessions sold. This shift towards offering larger concessions indicates a

desire to attract potential investors by granting them rights to extensive areas, which may seem attractive especially if their price has been falling in recent years. Furthermore, the lengths of the concessions in 2023, extending to 10 or even 20 years for the first time, further reflect a strategic adjustment by the state to make these investments more appealing.

This strategic interplay of concession numbers, area sizes, pricing strategies, and duration underscores a nuanced approach by the Ukrainian government to balance immediate financial needs with the long-term management of its natural resources. While these strategies provide necessary revenue streams, they also raise important questions about the sustainability and environmental impacts of such practices, especially in regions close to protected areas, suggesting a complex balancing act between economic development and environmental conservation.

5.1.2. Peat Concessions: Price Trends and Conflict

The licensing of peat concessions in Ukraine has seen a significant increase in the price per hectare, particularly in the last year. This trend can be attributed to a number of factors, most notably the increasing recognition of peat as a potential energy source during the ongoing conflict. With traditional energy supplies disrupted by the war, peat has emerged as a valuable alternative, leading to a surge in demand. This increased demand is likely to explain the rise in prices, as previously undervalued peatlands become critical resources. The economic pressures of the war have thus changed the market dynamics, making peat extraction a more lucrative endeavour than in previous years.

5.2. Potential Environmental and Social Impacts of Amber Mining in Ukraine

5.2.1. Impact on Protected Areas

The expansion of amber mining in Ukraine poses a significant threat to protected areas, particularly in cases of one of the largest sold concessions "Єльне-1", which is located worryingly close to the "Syra Pogonia Bog". This peatland is not only part of the Rivne Nature Reserve but also designated as a Ramsar site, recognized internationally for its conservation value. Situated on the border of this unique habitat, the Єльне-1 concession threatens the integrity of these peatlands as they could lead to significant degradation caused, for example, by drainage.

The destruction of peatlands such as Syra Pogonia can have devastating consequences, especially from hydrological and climate perspectives. Peatlands are essential for water regulation, including flood prevention and maintaining river flows during dry periods. Furthermore, they are significant carbon stores, sequestering large amounts of carbon dioxide. Disruption of these ecosystems through mining can lead to the release of stored carbon, exacerbating climate change (Convention on Wetlands, 2021). Moreover, the Syra Pogonia extends north into Belarus, forming large peatland complexes that are interconnected. Mining activities that lead to drainage or degradation of one part can have cascading effects throughout the entire complex, undermining conservation efforts across national borders.

The proximity of amber mining activities to such a vital and vulnerable ecological area highlights the urgent need for stricter regulatory oversight. Protecting these environments requires immediate action to prevent irreversible damage, ensuring that economic activities do not compromise critical natural habitats that are vital for biodiversity, climate stability, and water regulation.

5.2.2. Community and Legal Concerns

Amber mining in Ukraine has a profound impact on local communities, particularly through ecological disruption that affects their livelihoods and quality of life. Furthermore, these impacts often involve violations of the Aarhus Convention, to which Ukraine is a signatory. This international treaty requires public access to environmental information, participation in decision-making and access to justice in environmental matters.

In regions such as Zhytomyr and Rivne, which are affected by both legal and illegal amber mining, there is significant evidence of non-compliance with the Aarhus Convention. Communities report a lack of access to key information about mining activities, which prevents them from effectively participating in environmental governance. This opacity in operations prevents meaningful local input into decision-making processes, directly affecting their ability to manage and respond to environmental changes caused by mining.

The economic impact on these communities is severe and is exacerbated by the practices of many mining companies. In particular, companies often fail to pay taxes in the regions where mining takes place, opting instead to make financial contributions in jurisdictions that do not directly bear the burden of mining activities. This practice deprives local communities of vital revenues that could support public services and infrastructure development, exacerbating economic disparities and stunting local development (Mining Technology, 2017).

Post-mining land reclamation presents its own set of challenges. According to a report by Suspilne Media, companies in the Rivne region are required to reclaim land after amber extraction, but the effectiveness of these efforts is questionable. The soil, which is often mixed with sand during the mining process, is degraded and unsuitable for traditional uses such as agriculture. Reforestation efforts on these degraded lands are rarely successful, which may lead to increased fire hazards in the future due to poor vegetation growth (Suspilne Media, 2023).

Furthermore, the expansion of legal amber extraction poses significant environmental risks. Often located in remote and hard-to-reach areas, these legal mining operations require the construction of access roads and infrastructure that fragment ecosystems and can be more destructive than the mining itself. This industrial-scale disruption can lead to more severe ecological damage than smaller-scale illegal operations, challenging the notion that legal mining is inherently less harmful.

To foster sustainable development in the amber sector, it is crucial for the Ukrainian government to enforce the Aarhus Convention rigorously. This would involve improving transparency, ensuring community involvement in environmental decision-making, and conducting comprehensive Environmental Impact Assessments (EIAs) before project initiation. By aligning mining practices with these provisions, Ukraine can mitigate negative social impacts and promote a more inclusive approach to natural resource management.

5.3. Amber Trade and Its Impact on Poland and Ukraine

The amber industry is of significant economic and cultural importance in both Poland and Ukraine. While Poland, particularly the city of Gdańsk, is renowned for its amber craftsmanship, the raw material primarily originates from Ukraine and Russia. Despite Poland's rich history with amber, its domestic extraction is minimal. Instead, Poland relies heavily on imported amber, much of which is smuggled illegally from Ukraine. This dynamic has led to a complex market where a substantial portion of the amber processed in Poland lacks proper documentation, raising significant legal and environmental concerns (Stachowiak et al., 2018; Szczepaniak et al., 2018).

Illegal amber mining in Ukraine, especially in regions like Volyn and Polesie, has escalated to an industrial scale, causing extensive environmental degradation and social unrest. The uncontrolled extraction methods, often carried out by organized crime groups, have devastated large areas of land, transforming them into barren landscapes reminiscent of war zones. This illegal trade not only

deprives the Ukrainian government of valuable revenue but also contributes to widespread corruption and violence. Estimates suggest that around 60-70 tons of amber are smuggled into Poland annually, highlighting the scale of this black market (Stachowiak et al., 2018).

Poland's role in the amber trade is primarily as a processing and manufacturing hub. Gdańsk is a global center for amber jewelry, attracting tourists and buyers from around the world. However, the reliance on smuggled amber raises significant ethical and sustainability issues. The Polish amber industry, despite its global reputation, is deeply intertwined with the illegal extraction activities in Ukraine. This situation underscores the need for stricter regulatory frameworks and international cooperation to ensure the legality and sustainability of the amber supply chain (Pomorskie.travel, 2020; Szczepaniak et al., 2018).

It is crucial to note that Poland does not engage in large-scale amber extraction but instead works extensively with raw materials sourced from Ukraine and Russia. This aspect is particularly relevant for jewelry producers, such as those in Germany, who utilize Polish amber. Understanding the origins of this amber is essential for ensuring ethical sourcing and supporting initiatives aimed at legal and sustainable mining practices (Stachowiak et al., 2018).

Addressing these issues requires a comprehensive strategy that includes legalizing and regulating amber mining in Ukraine, enhancing border controls to prevent smuggling, and fostering greater transparency in the amber market. By implementing these measures, both countries can protect their natural environments, support local communities, and maintain the integrity of the amber industry. This approach not only preserves the ecological and economic value of amber but also promotes ethical practices and international cooperation in managing natural resources (Stachowiak et al., 2018; Szczepaniak et al., 2018).

5.4. Limitations and Future Directions of the Study

This study has relied exclusively on publicly available data, which inherently limits the scope and depth of the analysis. A notable limitation is the lack of data for Volyn Oblast, a significant region for amber extraction, which prevents a comprehensive understanding of the national landscape. In addition, this research did not use satellite imagery, which could provide more detailed insights into the environmental impacts of amber and peat mining, such as landscape changes and deforestation rates.

Furthermore, analysis of legal and illegal amber seized at the Polish-Ukrainian border could provide valuable insights into the illicit trade and economic aspects of amber mining. Such data would help to quantify the scale of illegal activities and their economic impact, contributing to more informed policy-making and enforcement strategies.

Looking ahead, it would be beneficial to continue this study on an annual basis to monitor trends and changes in response to evolving economic and political conditions. Future research should aim to include data from regions that are not currently covered, and use advanced techniques such as satellite imagery analysis to gain a more comprehensive understanding of the impacts of mining activities. Expanding the scope of the study to include cross-border trade dynamics and the effectiveness of regulatory changes post-2019 could also provide critical insights into amber and peat markets.

6. Conclusion

Research on amber licensing and extraction in Ukrainian Polesia has highlighted the complex interactions between legislative reforms, market dynamics and the socio-environmental impacts of resource extraction. Regulations introduced in 2019 aimed to curb illegal mining and increase transparency, and while these reforms were intended to more effectively regulate the amber market, the direct impact on the landscape of amber extraction remains difficult to accurately

quantify without further data. Observations from the data include an initial increase in the number of concessions granted in 2021, followed by a decrease in both the number of concessions and their average price per hectare.

These regulatory adjustments appear to be part of broader strategic shifts, including the extension of concession terms and price adjustments to attract investment during economic and geopolitical challenges. The implications of these strategies extend beyond amber to other resources such as peat, which is increasingly recognised as a valuable alternative energy source in the event of disruptions to traditional energy supplies.

The study also identifies significant concerns about the environmental and social impacts of mining activities. For example, the proximity of amber concessions to sensitive ecological areas such as the Syra Pogonia bog poses risks to biodiversity and ecosystem services. In addition, local communities often face economic, environmental and social challenges, including violations of the Aarhus Convention and inadequate reclamation of mined land.

Although comprehensive, this research is limited by the availability of publicly available data and the lack of detailed information for regions such as Volyn Oblast. In addition, the lack of analysis of satellite imagery could have provided more detailed insights into the environmental impacts of mining activities.

In conclusion, while the 2019 legislative changes have potentially laid the groundwork for a more regulated amber mining industry, the full impact of these regulations on ensuring sustainable and equitable resource management in Ukrainian Polesia is yet to be fully understood. Going forward, increased transparency, stricter enforcement of environmental regulations, and greater community involvement in environmental governance will be critical to achieving sustainable resource management and protecting both the natural environment and the well-being of local communities.

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