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LIST OF BEE SPECIES (HYMENOPTERA, APOIDEA) OF LVIV CITY (UKRAINE). PART I. FAMILIES ANDRENIDAE LATREILLE, 1802 AND APIDAE LATREILLE, 1802

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Background. The article presents the results of the research on bees (Hymenoptera, Apoidea) that occur in the city of Lviv. Bees are effective and important pollinators of many wild and agricultural angiosperm plants. However, bees are very sensitive to the environmental changes, especially to changes caused by humans. Urbanization often degrades nesting habitats for bees, decreases the abundance of oligolectic species, etc. Many different factors may have various effects on different species of bees. Thus, such investigations are very important and topical. A comprehensive study of all Apoidea the on the whole territory of the city of Lviv has been conducted for the first time in more than 80 years and we hope that presented materials will lay the foundation for further more detailed studies in this area.

Materials and Methods. Lviv is the largest city in Western Ukraine located on the eastern edge of the Roztochia Upland. The material was collected during warm period of 2017–2019. The Moericke (yellow) pan traps and the entomological nets were used. Also we collected dead bees (killed by traffic) along the roads. Besides, we analyzed the entomological collection of the Zoological Museum of the Ivan Franko National University [ZMD] (Lviv). The stereoscopic microscope and different specialized keys for bee species identification were used.

Results. We analyzed 960 specimens of bees which belong to 106 species, 25 genera and 6 families (Apidae, Andrenidae, Colletidae, Halictidae, Megachilidae and Melittidae). In the first part of present study, we review two families: Andrenidae and Apidae. In our collection, the family Andrenidae is presented by 32 species and family Apidae by 33 species.

Conclusions. All of these species are native for the territory of Europe. The majority of them are polylectic (80 % of all collected Apidae and Andrenidae excluding kleptopara-

sitic species; 60 % in total) and nest in soil (96 % and 72 % respectively). Most part of analyzed species is listed within two categories of the IUCN Red List: “Least Concern” – 43 species (66 % of all collected Apidae and Andrenidae); “Data Deficient” – 20 species (31 % respective). Only two species (3 %) are listed as “Near Threatened” (*Andrena hattorfiana* (Fabricius, 1781) and *A. ovatula* (Kirby, 1802)). *Xylocopa valga* Gerstäcker, 1872 has a conservation status of “Rare” in the Red Data Book of Ukraine.

Keywords: bees, species diversity, Andrenidae, Apidae, Lviv, Ukraine

INTRODUCTION

Bees are one of the most important pollinators of many species of wild angiosperm plants. They are an integral component of many ecosystems. However, apart from wild plants, bees are also effective pollinators of many crops, orchards and ornamental flower beds on the farmlands and in the cities.

Research of wild bees in urban context started relatively recently [1]. Over the past two decades, numerous contributions on the implications of urbanization for biodiversity conservation have been published [10]. Most of the investigations show negative impacts of urbanization on wild bees. For example, the effects of pesticides, emerging pathogens from managed bees, climate change and land-use change are negatively correlated with bee species richness [2, 3, 6, 7, 9]. Higher diversity of flowering plants due to domestic orchards and ornamental flowers attract many polylectic species, but the abundance of oligolectic species could decrease at the same time. Urbanization often degrades nesting habitats for ground-nesting bees, but various structures like buildings and fences, can lead to an increase in abundance of cavity-nesters in urban habitats [2]. Each of these factors may have different effects on different species of bees [3]. Despite a large number of investigations, many urbanization factors that influence biodiversity and pollination remain unstudied [14]. So, such research is very important and topical today.

History of Apoidea research on the territory of Lviv Region. Detailed entomological studies of the superfamily Apoidea on the territory of modern Western Ukraine began approximately 150 years ago for the first time. Maximilian Nowicki [23] and Antoni Wierzejski [24, 25] laid the foundation for these studies. Their work was continued by Jan Śnieżek who worked on bumblebees and bees generally [26]. But the most fundamental contribution to the development of apidology in the Eastern Poland and Galicia was made by Jan Noskiewicz at the beginning of 20th century. In his papers, the detailed faunistic composition of bees on the territory of Galicia, especially in Ukrainian Roztochia and Lviv with its outskirts (Ivano-Frankove, Yavoriv, Vynnyky, etc.) and the description of the insects’s morphology and physiology were given [18 – 22]. Significant research on the territory of Western Ukraine was also conducted by Hanna Osychnyuk [27–29]. However, she relied on Noskiewicz’s data regarding the bees of the city of Lviv and its outskirts.

Among the recent investigations of Apoidea (genus *Bombus* Latreille, 1802) on the territory of Lviv (and Western Ukraine in general), contributions published by Iryna Konovalova should be noted [8, 11].

The current research of all Apoidea on the territory of Lviv is conducted for the first time.

MATERIALS AND METHODS

Lviv is the largest city in Western Ukraine and the seventh-largest city in the country overall with total area of 182.01 km^2. It is located on the edge of the Roztochia Upland. Lviv urban landscape is complemented and enriched with numerous parks and public gardens. There are over twenty parks and three botanical gardens.

The objects of our research were bees (Hymenoptera, Apoidea) that occur on the territory of the city of Lviv. We collected the specimens during the warm period of 2017–2019. We used the Moericke (yellow) pan traps and the entomological nets. Moericke yellow trap is a type of the attraction traps (insects are attracted by colour) [16]. We used pans of 18 cm in diameter and 7 cm in depth. Traps were filled with water and a few drops of detergent were added.

Also, we collected dead bees (mostly killed by traffic) along the roads. Besides, we analyzed the entomological collection of Zoological Museum of Ivan Franko National University of Lviv (ZMD), collected during 2001–2016.

We used stereoscopic microscope MBS-2 and different specialized keys for bee species identification [4, 5, 12, 13, 30, 31, 33]. The higher level classification of bees follows Ch. D. Michener [15]. Information about IUCN Red List Categories was obtained from the “European Red List of bees” [17]. Information about species biology was taken from the relevant literature [4, 5, 12, 13, 30, 33].

RESULTS AND DISCUSSION

During the research, 960 specimens of bees that belong to 106 species, 25 genera and 6 families (Apidae, Andrenidae, Colletidae, Halictidae, Megachilidae and Melittidae) were examined. In this first part of our study, we review two families: Andrenidae (348 examined specimens) and Apidae (411 examined specimens).

The family Andrenidae in our collection is presented by 32 species from two genera – *Andrena* Fabricius, 1775 and *Panurgus* Panzer 1806 (**Table 1**).

Table 1. **Bees of the family Apidae occurring on the territory of the city of Lviv**

Таблиця 1. **Бджолині родини Andrenidae, поширені на території м. Львова**

No	Species	Species biology	Conservation
1.	*Andrena bicolor* Fabricius, 1775	Solitary. Bivoltine (March–June; June–August). Polylectic. Nest in soil	LC
2.	*A. bimaculata* (Kirby, 1802)	Solitary. Bivoltine (March–May; July–August). Polylectic. Nest in soil	DD
3.	*A. chrysosceles* (Kirby, 1802)	Solitary. Univoltine (April–June). Polylectic. Nest in soil	DD
4.	*A. cineraria* (Linnaeus, 1758)	Solitary. Univoltine (April–July). Polylectic. Nest in soil	LC
5.	*A. denticulata* (Kirby, 1802)	Solitary. Univoltine (July–September). Polylectic, with preference to Asteraceae. Nest in soil	DD
6.	*A. dorsata* (Kirby, 1802)	Solitary. Bivoltine (March–May; July–August). Polylectic. Nest in soil	DD
7.	*A. flavipes* Panzer, 1799	Solitary. Bivoltine (March–June; July–September). Polylectic. Nest in soil	LC

No	Species	Species biology	Conservation
8.	*A. florea* Fabricius, 1793	Solitary. Univoltine (May–July). Oligolectic on *Bryonia* L. (Cucurbitaceae). Nest in soil	DD
9.	*A. floricola* Eversmann, 1852	Solitary. Bivoltine (April–May; July–August). Polylectic, with preference to Brassicaceae and Apiaceae. Nest in soil	DD
10.	*A. fucata* Smith, 1847	Solitary. Univoltine (May–July). Polylectic. Nest in soil	DD
11.	*A. gravida* Imhoff, 1832	Solitary. Univoltine (April–May). Polylectic. Nest in soil	DD
12.	*A. haemorrhoa* (Fabricius, 1781)	Solitary. Univoltine (March–June). Polylectic. Nest in soil	LC
13.	*A. hattorfiana* (Fabricius, 1775)	Solitary. Univoltine (June–August). Oligolectic on *Knautia* L. (Caprifoliaceae). Nest in soil	NT
14.	*A. humilis* Imhoff, 1832	Solitary. Univoltine (May–July). Oligolectic on Asteraceae. Nest in soil	DD
15.	*A. labialis* (Kirby, 1802)	Solitary. Univoltine (May–July). Polylectic, with preference to Fabaceae. Nest in soil	DD
16.	*A.* lapponica Zetterstedt, 1838	Solitary. Univoltine (April–June). Polylectic. Nest in soil	LC
17.	*A. lathyri* Alfken, 1899	Solitary. Univoltine (April–June). Oligolectic on Fabaceae (mainly *Lathyrus* L.). Nest in soil	DD
18.	*A. lepida* Schenck, 1861	Solitary. Bivoltine (March-May; July–August). Polylectic. Nest in soil	DD
19.	*A. limata* Smith, 1853	Solitary. Bivoltine (April–September). Polylectic. Nest in soil	DD
20.	*A. minutula* (Kirby,1802)	Solitary. Bivoltine (March–June; June–September). Polylectic. Nest in soil	DD
21.	*A. nitida* (Müller,1776)	Solitary. Univoltine (April–June). Polylectic. Nest in soil	LC
22.	*A. ovatula* (Kirby, 1802)	Solitary. Bivoltine (March–June; June–September). Polylectic, with preference to Fabaceae. Nest in soil	NT
23.	*A. paucisquama* Noskiewicz, 1924	Solitary. Univoltine (May–June). Oligolectic on *Campanula* L. (Campanulaceae). Nest in soil	DD
24.	*A. pilipes* Fabricius, 1781	Solitary. Bivoltine (April–May; July–August). Polylectic. Nest in soil	LC
25.	*A. praecox* (Scopoli, 1763)	Solitary. Univoltine (March–May). Polylectic. Nest in soil	LC
26.	*A. proxima* (Kirby, 1802)	Solitary. Univoltine (May–June). Oligolectic on Apiaceae. Nest in soil	DD
27.	*A. rosae* Panzer, 1801	Solitary. Bivoltine (April–May; July–August). Polylectic. Nest in soil	DD
28.	*A. schencki* Morawitz, 1866	Solitary. Univoltine (May–July). Polylectic. Nest in soil	DD
29.	*A. subopaca* Nylander, 1848	Solitary. Univoltine (May–July). Polylectic. Nest in soil	LC

No	Species	Species biology	Conservation
30.	*A. tibialis* (Kirby, 1802)	Solitary. Univoltine (April–July). Polylectic. Nest in soil	LC
31.	*A. ventralis* Imhoff, 1832	Solitary. Univoltine (March–May). Polylectic. Nest in soil	DD
32.	*Panurgus calcaratus* (Scopoli, 1763)	Solitary. Univoltine (June–September). Oligolectic on yellow-flowered Asteraceae. Nest in soil	LC

Comments: Species conservation (IUCN Red List Categories): LC – Least concern, DD – Data deficient, NT – Near Threatened

Примітки: Охорона видів (категорії Червоного списку МСОП): LC – "Найменший ризик", DD – "Відомостей недостатньо", NT – "Близький до загрозливого стану"

The majority of the collected Andrenidae are listed in two categories of the IUCN Red List: "Data Deficient" – 19 species and "Least Concern" – 11 species. Only two species are listed as "Near Threatened" – *Andrena hattorfiana* and *A. ovatula*. Specimens of both species were collected dead along the roads (were damaged by traffic).

All collected Andrenidae are native for the territory of Europe, solitary and nesting in soil. 25 species (78 % of all collected Andrenidae) are polylectic and 7 species (22 %) are oligolectic.

The family Apidae in our collection is presented by 33 species from 10 genera – *Anthophora* Latreille, 1803, *Apis* Linnaeus, 1758, *Bombus* Latreille, 1802, *Epeoloides* Giraud, 1863, *Epeolus* Latreille, 1802, *Eucera* Scopoli, 1770, *Melecta* Latreille, 1802, *Nomada* Scopoli, 1770, *Tetraloniella* Ashmead, 1899, *Xylocopa* Latreille, 1802 (**Table 2**).

Table 2. **Bees of the family Apidae occurring on the territory of Lviv City**

Таблиця 2. **Бджолині родини Apidae, поширені на території м. Львова**

No	Species	Species biology	Conservation
1.	*Anthophora aestivalis* (Panzer, 1801)	Solitary. Univoltine (March–August). Polylectic. Nest in soil	LC
2.	*A. furcata* (Panzer, 1798)	Solitary. Univoltine (May–August). Oligolectic on Lamiaceae. Nest in soil or in rotten wood and plant stems	LC
3.	*A. plumipes* (Pallas, 1772)	Solitary. Univoltine (March–May). Polylectic. Nest in soil	LC
4.	*Apis mellifera* Linnaeus, 1758	Eusocial. Have perennial colonies with flight period from March to October. Polylectic. Nest in artificial hives or in the tree cavities	DD
5.	*Bombus barbutellus* (Kirby, 1802)	Kleptoparasite. Flight from April to September. It does not collect pollen. Parasite in nests of *B. hortorum* (Linnaeus, 1761)	LC
6.	*B. bohemicus* (Seidl, 1837)	Kleptoparasite. Flight from April to August. It does not collect pollen. Parasite in nests of *B. lucorum* Linnaeus, 1761	LC
7.	*B. campestris* (Panzer, 1801)	Kleptoparasite. Flight from April to September. It does not collect pollen. Parasite in nests of *B. humilis* Illiger, 1806, *B. muscorum* (Linnaeus,1758), *B. pascuorum* (Scopoli,1763), *B. ruderarius* (Fabricius,1793) and *B. sylvarum* (Linnaeus, 1761)	LC

No	Species	Species biology	Conservation
8.	*B. hortorum* (Linnaeus, 1761)	Eusocial. Flight from March to October. Polylectic. Nest in soil cavities or on its surface	LC
9.	*B. hypnorum* (Linnaeus, 1758)	Eusocial. Flight from March to September. Polylectic. Nest in soil cavities or on its surface	LC
10.	*B. lapidarius* (Linnaeus, 1758)	Eusocial. Flight from March to October. Polylectic. Nest in soil cavities	LC
11.	*B. lucorum* Linnaeus, 1761	Eusocial. Flight from March to September. Polylectic. Nest in soil cavities or on its surface	LC
12.	*B. pascuorum* (Scopoli, 1763)	Eusocial. Flight from March to October. Polylectic. Nest in soil cavities or on its surface	LC
13.	*B. pratorum* (Linnaeus, 1761)	Eusocial. Flight from March to July. Polylectic. Nest in soil cavities or on its surface	LC
14.	*B. ruderarius* (Müller, 1776)	Eusocial. Flight from April to September. Polylectic. Nest in soil cavities or on its surface	LC
15.	*B. rupestris* (Fabricius, 1793)	Kleptoparasite. Flight from May to August. It does not collect pollen. Parasite in nests of *B. lapidarius* (Linnaeus, 1758)	LC
16.	*B. sylvarum* (Linnaeus, 1761)	Eusocial. Flight from May to September. Polylectic. Nest in soil cavities or on its surface	LC
17.	*B. sylvestris* Lepeletier, 1832	Kleptoparasite. Flight from April to September. It does not collect pollen. Parasite in nests of *B. pratorum* (Linnaeus, 1761)	LC
18.	*B. terrestris* (Linnaeus, 1758)	Eusocial. Flight from March to October. Polylectic. Nest in soil cavities	LC
19.	*B. vestalis* (Geoffroy, 1785)	Kleptoparasite. Flight from April to August. It does not collect pollen. Parasite in nests of *B. terrestris* (Linnaeus, 1758)	LC
20.	*Epeoloides coecutiens* (Fabricius, 1775)	Kleptoparasite. Flight from June to August. It does not collect pollen. Parasite in nests of *Macropis europaea* Warncke, 1973, *M. fulvipes* (Fabricius 1805)	LC
21.	*Epeolus variegatus* (Linnaeus, 1758)	Kleptoparasite. Flight from June to August. It does not collect pollen. Parasite in nests of *Colletes daviesanus* Smith, 1846, *C. fodiens* (Geoffroy,1785), *C. halophilus* Verhoeff, 1943, *C. succinctus* (Linnaeus,1758)	LC
22.	*Eucera longicornis* (Linnaeus, 1758)	Solitary. Univoltine (May–July). Oligolectic on Fabaceae. Nest in soil	LC
23.	*E. nigrescens* Pérez, 1879	Solitary. Univoltine (June–July). Oligolectic on Fabaceae. Nest in soil	LC
24.	*Melecta albifrons* (Forster, 1771)	Kleptoparasite. Flight from April to June. It does not collect pollen. Parasite in nests of *Anthophora plumipes* (Pallas, 1772), *A. fulvitarsis* Brullé, 1832 and *A. parietina* Fabricius 1793	LC
25.	*Nomada alboguttata* Herrich-Schäffer, 1839	Kleptoparasite. Bivoltine (April–June; July–September). It does not collect pollen. Parasite in nests of *Andrena barbilabris* (Kirby, 1802), *A. ventralis* Imhoff, 1832, *A. argentata* Smith, 1844	LC
26.	*N. bifasciata* Olivier, 1811	Kleptoparasite. Flight from March to June. It does not collect pollen. Parasite in nests of *Andrena gravida* Imhoff, 1832	LC
27.	*N. flavoguttata* (Kirby, 1802)	Kleptoparasite. Flight from March to September. It does not collect pollen. Parasite in nests of *Andrena* spp.	LC

No	Species	Species biology	Conservation
28.	*N. fucata* Panzer, 1798	Kleptoparasite. Bivoltine (April–June; July–August). It does not collect pollen. Parasite in nests of *Andrena flavipes* Panzer, 1799	LC
29.	*N. moeschleri* Alfken, 1913	Kleptoparasite. Flight from April to June. It does not collect pollen. Parasite in nests of *Andrena haemorrhoa* (Fabricius, 1781), *A. helvola* (Linnaeus, 1758), *A. fucata* Smith, 1847	LC
30.	*N. ruficornis* (Linnaeus, 1758)	Kleptoparasite. Flight from March to July. It does not collect pollen. Parasite in nests of *Andrena haemorrhoa* (Fabricius, 1781)	LC
31.	*N. sexfasciata* Panzer, 1799	Kleptoparasite. Flight from May to July. It does not collect pollen. Parasite in nests of *Eucera* spp.	LC
32.	*Tetraloniella dentata* (Germar, 1839)	Solitary. Univoltine (May–August). Polylectic. Nest in soil	LC
33.	*Xylocopa valga* Gerstäcker, 1872	Subsocial. Univoltine (April–September). Polylectic. Nest in the wood	LC Rare*

Comments: Species conservation (IUCN Red List Categories): LC – Least concern, DD – Data deficient; Rare* – conservation status follows to the Red Data Book of Ukraine

Примітки: Охорона видів (категорії Червоного списку МСОП): LC – "Найменший ризик", DD – "Відомостей недостатньо", "Рідкісний*" – природоохоронний статус виду відповідно до Червоної книги України

Most of the Apidae are listed in the IUCN Red List in the category "Least Concern" (32 species) and only one species (*Apis mellifera*) is listed as "Data Deficient". *Xylocopa valga* has a conservation status "Rare" in the Red Data Book of Ukraine [32].

Among the collected Apidae, five species are solitary and nesting in soil, one is solitary and nesting in soil or in rotten wood (or plant stems), one is subsocial and nesting in wood, 10 are eusocial and nesting in soil cavities or on its surface (except for *A. mellifera,* which nests in artificial hives or in tree cavities), 16 are kleptoparasitic species. Finally, 14 species (42 % of all collected Apidae) are polylectic, 3 species (9 %) are oligolectic and 16 species (49 %) do not need to collect pollen due to their kleptoparasitism.

CONCLUSIONS

The current composition of the bees' fauna of Andrenidae and Apidae within the city of Lviv includes 65 species. These two families are the richest by the number of species among all the six families that occur on the territory of Lviv. The family Andrenidae is presented by 32 species from 2 genera and tha family Apidae is presented by 33 species from 10 genera.

All species discussed above are native for the territory of Europe. The majority of them are polylectic (80 % of all collected Apidae and Andrenidae excluding kleptoparasitic species; 60 % in total, including kleptoparasitic species), and nesting in soil (96 % of all collected Apidae and Andrenidae excluding kleptoparasitic species; 72 % in total). The predominance of polylectic species which can forage on a variety of plant species was predictable since this group of bees is easier to adapt to the changes of environmental conditions.

The majority of the studied species are listed in two categories in the IUCN Red List: "Least Concern" – 43 species (66 % of all collected Apidae and Andrenidae in total); "Data Deficient" – 20 species (31 %). Only two species (3 %) are listed as "Near Threa-

tened" (*Andrena hattorfiana* and *A. ovatula*). In addition, one species (*Xylocopa valga*) has a conservation status "Rare" in the Red Data Book of Ukraine.

This research can lay the foundation for further studies in this area.

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COMPLIANCE WITH ETHICAL STANDARDS

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Human Rights: This article does not contain any studies with human subjects performed by the any of the authors.

Animal studies: All institutional, national and institutional guidelines for the care and use of laboratory animals were followed.

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СПИСОК ВИДІВ БДЖОЛИНИХ (HYMENOPTERA, APOIDEA) НА ТЕРИТОРІЇ ЛЬВОВА (УКРАЇНА). ЧАСТИНА І. РОДИНИ ANDRENIDAE LATREILLE, 1802 І APIDAE LATREILLE, 1802

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Вступ. У статті представлено результати досліджень бджолиних (Hymenoptera, Apoidea), які трапляються на території м. Львова. Бджолині є ефективними та важливими запилювачами багатьох диких та сільськогосподарських покритонасінних рослин. Однак ці комахи дуже чутливі до середовища існування, особливо антропогенно зміненого. Урбанізація часто погіршує середовище для гніздування бджолиних, зменшує кількість видів-оліголектів тощо. Багато чинників можуть по-різному впливати на різні види бджолиних, тож їхнє дослідження є на сьогодні дуже актуальним. Дослідження усіх бджолиних загалом на території м. Львова проводиться вперше за більш ніж 80 років, і ми сподіваємося, що ці матеріали стануть основою для подальших більш детальних досліджень у цій сфері.

Матеріали та Методи. Львів є найбільшим містом у західній Україні й розташований на краю горбистого пасма Розточчя. Матеріал збирали впродовж теплого періоду 2017–2019 років. Для лову комах ми використовували ентомологічні сачки та пастки Меріке. Також збирали комах, збитих транспортом на дорозі. Крім цього, аналізували ентомологічні колекції Зоологічного музею Львівського національного університету імені Івана Франка. Для визначення комах використовували стереоскопічний мікроскоп і спеціальні визначники.

Результати. Протягом досліджень ми проаналізували 960 зразків бджолиних, котрі належать до 106 видів, 25 родів і 6 родин (Apidae, Andrenidae, Colletidae, Halictidae, Megachilidae та Melittidae). У цій статті представлено дві родини: Andrenidae та Apidae. Родина Andrenidae у наших зборах представлена 32 видами, а родина Apidae – 33.

Висновки. Усі досліджені види є аборигенними для території Європи. Більшість із них є полілектами (80 % від видів обох родин з виключенням клептопаразитів; 60 % від загальної кількості видів із двох родин) та гніздяться у ґрунті (96 % та 72 % відповідно). Більшість проаналізованих видів у Червоному списку МСОП фігурують у двох категоріях: “Найменший ризик” – 43 види (66 % від суми видів обох родин); “Відомостей недостатньо” – 20 видів (31 %). Тільки два види (3 %) належать до категорії “Близький до загрозливого стану” (*Andrena hattorfiana* та *A. ovatula*). Також один вид (*Xylocopa valga*) занесений до Червоної книги України у статусі “Рідкісний”.

Ключові слова: бджолині, видове різноманіття, Andrenidae, Apidae, Львів, Україна

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