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THE JACKAL (*CANIS AUREUS*) IN THE ZONE OF OCCUPATION AND HOSTILITIES IN UKRAINE: A BIOGEOGRAPHICAL ANALYSIS

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Abstract

The history of the jackal's expansion into the eastern part of Ukraine (in fact, all regions east of the Dnipro River) during the first quarter of the 21st century is examined in detail. The dynamics of the jackal's settlement and the specifics of its spread in eastern Ukraine, in the regions east of the Dnipro River (in fact, east of the Odesa–Kyiv line), covering all areas of current hostilities and occupation zones, are analysed. The study is based on a detailed OSINT analysis of data from all types of open sources and reports from local residents and colleagues, including wildlife experts, and partly on publications, which are very scarce. Unlike the right-bank part of the country, the source of this expansion was the jackal populations living on the pre-Caucasian plains, separated from Ukraine by the Sea of Azov, the Lower Don, and the Kerch Strait. It has been shown that the expansion took place in several waves, with the main phase of settlement in the region occurring between 2005 and 2015, i.e. before the period of catastrophic changes in all traditional forms of nature use and before the period of active hostilities as a result of Russian aggression against Ukraine. Over two decades, a cluster system of settlements has formed, numbering about 10 and spaced about 70–100 km apart. Most of these clusters are associated with river floodplains, reservoir bays, estuaries, and, less frequently, ravine-balka systems. From there, jackals spread further, blurring the boundaries between clusters. Statistical data on the recording and hunting of jackals by hunters between 2011 and 2025 have been compiled, broken down by year and region. The current data is supplemented by a search for historical evidence of the appearance of jackals in the territory of modern Ukraine in the 18th–20th centuries. All such cases relate to the southern (coastal) regions and indicate that jackals have been appearing in the region on multiple occasions in historical times and, therefore, their status as a native species within its distribution range. Modern expansion can be interpreted as new fluctuation in the geographical range, which changes in accordance with the dynamics of climatic factors. The main factor in the restoration of the range is climate warming, primarily the reduction of areas with permanent winter snow cover, which allows jackals to successfully forage for food.

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Шакал (*Canis aureus*) у зоні окупації та бойових дій на сході й півдні України: біогеографічний аналіз

Ігор Загороднюк

Резюме. Розглянуто в деталях історію експансії шакала на територію східної частини України (фактично всіх областей на схід від Дніпра) протягом першої чверті XXI ст. Проаналізовано динаміку розселення та особливості поширення шакала на сході України, в регіонах на схід від Дніпра (фактично на схід від лінії Одеса–Київ), з охопленням всіх зон поточних бойових дій і зон окупації. Дослідження побудовано на детальному OSINT-аналізі даних з усіх типів відкритих джерел та повідомлень місцевих жителів і колег, зокрема й мисливствознавців, а частково й публікацій, яких дуже мало. Джерелом цієї експансії, на відміну від правобережної частини країни, стали популяції шакала, що мешкають на передкавказьких рівнинах і відділені від теренів України Азовським морем разом із Нижнім Доном і Керченською протокою. Показано, що експансія йшла кількома хвилями, і основна фаза заселення регіону припадає на 2005–2015 роки, тобто до періоду катастрофічних змін традиційних форм природокористування і до періоду розгортання активних бойових дій внаслідок російської агресії проти України. Протягом двох десятиліть сформувалася кластерна система поселень, яких можна налічити порядку 10 і між якими проміжки становлять порядку 70–100 км. Більшість таких кластерів пов'язані з річковими заплавами, затоками водосховищ, лиманами, рідше яружно-балковими системами. Звідти йде подальше розселення шакалів з розмиванням меж кластерів. Узагальнено статистичні дані щодо обліків і здобування шакала мисливцями протягом 2011–2025 рр. з деталізацією їх за роками і областями. Сучасні дані доповнено пошуком історичних свідчень про появи шакала на теренах сучасної України у XVIII–XX ст. Всі такі випадки стосуються південних (приморських) районів і свідчать про неодноразову появу шакала в регіоні в історичні часи і, отже, про його статус аборигена на межах свого поширення. Сучасна експансія може трактуватися як чергова пульсація меж географічного поширення, які змінюються відповідно до динаміки кліматичних факторів. Основним фактором відновлення ареалу є потепління клімату, передусім зменшення територій зі сталим зимовим сніговим покривом, що дозволяє шакалам успішно здійснювати кормодобування.

Ключові слова: шакал золотавий, експансія видів, зона бойових дій, Східна Європа.

Introduction

The golden jackal (*Canis aureus* Linnaeus 1758) is a southern species which, during the global cooling period, retreated from Eastern Europe far to the south; however, over the last 50 years, it has shown an increase in numbers in its northern populations and widespread expansion, which by the end of the 20th century had covered all southern and central Europe and the Caucasus isthmus [Arnold *et al.* 2012; Spassov & Acosta-Pankov 2019; Flores-Manzanero *et al*. 2026]. Accordingly, it is recommended that the status of this species, which is expected to be invasive, be regarded as a recovery of its range [Arnold *et al.* 2012]. However, as its range is expanding and its population is growing, including in Ukraine, this species does not require any conservation measures and should be included in the list of regulated species [Zagorodniuk 2014]. Given the significant expansion of its range far beyond any reconstructed historical distribution, it should be assigned different conservation statuses for different parts of its range.

Today, Ukraine has become the main area for the jackal's northward expansion in Eastern Europe. Despite numerous records of the species in the north, including Poland [Kowalczyk *et al.* 2015, 2020], the Ukrainian Polissia [Zhyla 2023], Belarus [Grichik *et al.* 2018] and as far as Estonia [Männil & Ranc 2022] and the Pskov region [Korablev *et al.* 2024], in Ukraine, particularly in the south, and especially in the coastal regions, sizeable local populations with high abundances of the species have formed [Domnich *et al.* 2009; Redinov 2015; Rozhenko 2017, 2021; Rusev 2020]. In addition, the species is regularly recorded in a number of other regions of Ukraine, although in many places these are isolated migrant individuals, which explains both the significantly lower density of such records on the map and their later dates [Zagorodniuk 2014]. Despite the large amounts of data accumulated,

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the picture of its expansion in relation to the territory of Ukraine appears extremely simplified and incomplete [see: Flores-Manzanero *et al*. 2026].

The aim of this study is to summarise data on the locations where jackals have been found and the characteristics of its expansion in eastern Ukraine (from the Dnipro region to the Luhansk and Donetsk regions), to analyse the spatial and temporal patterns of sightings in order to reconstruct possible routes of expansion, and to test biocoenotic and climatic hypotheses regarding the species' colonisation of the region.

Material

The study is based on a dataset comprising approximately 100–120 records of jackal sightings made throughout the observation period, covering the years 2000 to 2025.

The species record register listed below cover the area east of the Cherkasy–Mykolaiv line. The register is based on materials provided to the author by colleagues and on academic publications; however, a significant portion of the sources are 'grey literature': news websites, hunting forums, and reports from government bodies and veterinary services. In other words, the research is based on OSINT, using a number of verification criteria, including the presence of photographs, descriptions of the finds, and references to the experts involved in compiling the news and information reports. The most illustrative examples of photographic documentation of finds are presented in Fig. 1. Some of the problematic finds (ambiguous identifications) can be attributed to hybrids of jackals and feral dogs, which certainly exist and are discussed further in the 'Discussion' section.

The sources were therefore: (*a*) reports from colleagues regarding their own observations and verified reports from their close colleagues; (*b*) information from game experts and hunters whom the author or my colleagues contacted at my request; (*c*) information from hunting forums, supported by detailed descriptions or photographs, often involving direct contact to clarify details; (*d*) information from colleagues' scientific publications, in a number of cases with details clarified for this study; (*e*) information from official sources regarding jackal sightings (publications in the media and on the official websites of hunting societies, veterinary services, the State Consumer Union, the State Forestry Agency); and (*f*) media sources with reports on fauna, hunting grounds, jackals, and rabies.

The author received considerable assistance from colleagues who helped to locate hard-to-access sources (in particular D. Lazariev and V. Yakovlev), colleagues who assisted in the accurate identification of animals from photographs (especially M. Rozhenko), colleagues who clarified information regarding fundamentally important and, above all, historical records (A. Volokh, Z. Selyunina, and P. Chegorka), and colleagues who provided new information, including photographs of jackals (D. Pylypenko, O. Ponomarenko, V. Foroshchuk, and others). Most media sources are presented as direct links within the text in URL format; some of the most significant ones are provided in footnotes or in the list of publications. Active cooperation with many people—involving information from at least 50–60 colleagues and respondents—has enabled us to compile a verified database, key extracts from which are presented below in the 'Species record register' section.

Data from the State Statistical Reporting Form 2TP-Hunting, which was in use until early 2022, were also used. For this purpose, the tabular data used in the article on introduced alien mammal species in the fauna of Ukraine [Zagorodniuk & Lazariev 2024]. According to these data, the jackal has been included in the tables since 2011, meaning that data on population changes for over 15 years (2011–2025) are available.

The cartographic materials have been summarised for further analysis using Google Maps, where the relevant illustrations have also been generated. The data analysis takes into account the zonation of bioclimatic factors (such as MaxEnt [Novoseltseva 2024]) was not carried out at this stage, as the range is in the process of formation and is represented not by continuous zones with established range boundaries and density gradients, but by isolated clusters, which are analysed here. For a general analysis of the correlation between geographical range data and climatic factors, maps from the National Atlas of Ukraine ('Nature of Ukraine' portal, URL) and cartographic data from relevant publications [Kongoli *et al*. 2012; Yailymov *et al*. 2023] were used.

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Fig. 1. Photo records of the jackal in eastern Ukraine: (*a*) a group of jackals on a 'raid' in the vicinity of Novobakhmutivka, Donetsk Oblast (photo by D. Pylypenko); (*b*) a jackal hunted in 2010 in Luhansk Oblast (see text); (*c*) near the village of Industry in Luhansk Oblast (photo by O. Martynov, 30.04.2012), (*d*) a jackal from Mariupol in 2015 (photo by O. Bronskov, 2015); (*e*) Solyansky Raion (photo by R. Onufriev, 03.10.2019), (*f*) jackal caught by hunters near the village of Bezymenne in the vicinity of Novoazovsk (photo by V. Martynov, 17.11.2020), (*g*) jackal on Byriuchyi Island (photo by N. Suriadna, 16.10.2019), (*h*) jackal in the photo from hunters who had doubts about the species captured near Cherkasy (via P. Voitko, spring 2023); (*i*) jackal from the vicinity of Barynykivka, Luhansk Oblast (photo by hunters, 19.01.2025); (*j*) a jackal hunted in 2019 in Antratsytskyi Raion, Luhansk Oblast (via D. Lazariev, 2.10.2019); (*k*) a jackal hunted in the spring of 2022 near Irkliiv, Cherkasy Oblast (M. Klestov, pers. com., 08.02.2025).

Рис. 1. Фотореєстрації шакала за східної частини України: (*a*) група шакалів на рейді в окол. Новобахмутівки, Донецька обл. (фото Д. Пилипенка, 26.05.2011); (*b*) шакал у здобичі мисливців 2010 р. в Луганській обл. (див. текст); (*c*) окол. с. Індустрія на Луганщині (фото О. Мартинова, 30.04.2012), (*d*) маріупольський шакал 2015 р. (фото О. Бронскова, 2015); (*e*) Солянський р-н (фото Р. Онуфрієва, 03.10.2019), (*f*) шакал, здобутий мисливцями біля с. Безіменне в окол. Новоазовська (фото В. Мартинова, 17.11.2020), (*g*) шакал на о. Бирючий (фото Н. Сурядної, 16.10.2019), (*h*) шакал на фото від мисливців, які мали сумнів у визначенні виду здобичі, здобутої біля м. Черкаси (отримано через П. Войтка, весна 2023 р.); (*i*) шакал з окол. с. Бараниківка на Луганщині (фото від мисливців, 19.01.2025); (*j*) шакал, здобутий мисливцями 2019 р. в Антрацитівському районі Луганщини (отримано через Д. Лазарєва, 2.10.2019); (*k*) шакал, здобутий навесні 2022 р. біля с. Ірклiїв на Черкащині (М. Клестов, особ. повід., 08.02.2025).

1. Registration features

By the turn of the 20th and 21st centuries, the first phase of the jackal's expansion had essentially come to an end, and the species faced the wide plains of Eastern Europe, particularly Ukraine. Restrained by new biogeographical barriers, such as the Danube (to the north-west) and the Don (to the south-east), this species continued to increase in numbers in Romania [Banea *et al*. 2012] and the Ciscaucasia [Gineev 2019], so this new expansion was entirely expected. Jackals appeared in the Rostov region in 2002, and a marked increase in numbers in this area began in 2012 [Simonovich & Sidelnikov 2019]. The species' expansion across Ukraine began much earlier, at least 10 years before its recognition, the origins of which have been analysed previously [Zagorodniuk 2025].

Thus, in 2003, this species was recorded in the Bakhmut area, where hunters bagged a carnivore, which was identified as a jackal based on photographs published in the journal 'Hunting and Fishing' [Volokh 2003]. Three years later, there were further findings in eastern Ukraine, such as in Luhansk Oblast (Milove Raion) [Zagorodniuk 2006]. This process is discussed in more detail below. In Odesa Oblast, all this had been taking place for several years prior, since 1998 [Volokh *et al.* 1998], but it was not until 2010 that the same researchers confidently described the jackal as a new species for the fauna of Ukraine [Roženko & Volokh 2010]. According to these researchers, the very first jackal they found was a roadkill, which they identified as a Ussuri raccoon dog (A. Volokh, pers. comm.).

A notable series of posts regarding alleged jackal hunting can be found on the USHF forum, which has been preserved online (https://uoor.com.ua/forum, thread titled 'Jackal?')[1]. Among them is a find in the reeds near a village in Veselynivskyi Raion, Mykolaiv Oblast, on 15 November 2011, which was supported by photographs of the entire animal, its head and front paw with the typical U-shaped pads. Unfortunately, the inquisitive hunter was 'shamed' on the basis of an expert opinion from the 'Schmalhausen Institute' (i.e. the Institute of Zoology, NASU; V. Yakovlev, pers. comm.[2]); however, all the images undoubtedly depict a jackal.

During the author's time in Luhansk and whilst monitoring local media reports on wildlife, numerous accounts of 'red Chechen wolves' were noted. However, the very first reports from hunters (among perceptive students), who spoke of strange carnivores that were definitely not dogs, foxes, or wolves, with characteristic behavioural and morphological traits (pausing to watch and turning their heads, smaller than wolves and with short tails), allowed such descriptions to be attributed to the jackal [Zagorodniuk 2006]. Finally, doubts were dispelled by other findings of this species of carnivore in the Donbas [Volokh 2003]. Since then, jackals, which had previously been mistaken for wolves or foxes, have been recorded regularly.

A good example of this was the pack of 'wolves' in the vicinity of Novobakhmutivka, north of Donetsk: a series of photographs from May 2011, provided to the author by D. Pylypenko (one of which is shown in Fig. 1a), unequivocally confirmed the presence of a jackal, and this identification was confirmed by other jackal experts (in particular M. Rozhenko and S. Zhyla). In addition to habitat, season, and pack behaviour, key identifying features included body shape and behavioural traits—running short distances with pauses and characteristic head turns to assess potential threats from behind. Around the same time (early 2010), the first photograph of an animal bagged by hunters in Luhansk Oblast appeared (without details; see Fig. 1b and the register). This photo is still available at otveti.mail.ru (URL) with the verdict 'fox', although the morphology is unambiguously that of a jackal, as confirmed by colleagues (M. Rozhenko, pers. comm.).

2. Species record register

The cadastre covers sites located primarily east of the Dnipro River, as well as within the Dnipro Valley itself, extending only to certain adjacent areas on the right bank that clearly form cluster groups with the finds from the Dnipro region (Fig. 2). According to preliminary data, the jackal is present throughout the left-bank region, with a marked concentration of localities in the south and in the

[1] UHFS means Ukrainian Hunting and Fishing Society (known Ukrainian acronym as 'UTMR').
[2] In fact, V. Yakovlev was the forum moderator at the time ('S-Moderator', 9701 posts) and, where necessary, made enquiries to experts and institutions, including regarding the photographs in question.

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valleys of major rivers. There are several records in the north, notably in Kyiv Oblast, specifically in Chornobyl [Zhyla 2023], the Polissia Nature Reserve, in the vicinity of Tarashcha and Bila Tserkva (unpublished), and in the north of Sumy Oblast, near the village of Znob (2015), which are not analysed here. The same concerns the Black Sea region, within Mykolaiv and Odesa oblasts, as described in detail by colleagues [Redinov 2015; Nakonechnyi *et al*. 2019; Rusev 2020; Rozhenko 2021]; the exception is the territory of the Black Sea Nature Reserve [Redinov 2015; Nakonechnyi *et al*. 2019; Rusev 2020; Rozhenko 2021].

The distribution of the species is highly patchy, and there are numerous examples of its absence in certain areas, despite targeted searches (e.g., Askania-Nova, Kostiantynivka). Therefore, all data collected by the author have been grouped into clusters (groups of localities) based on geographical proximity, isolation from other similar sites, and chronology (clusters A–J). The descriptions are arranged in chronological order, both for the clusters and within the clusters. Asterisks preceding individual codes (e.g., '*A1') indicate jackal finds prior to 2010, which the author lists in a review of the earliest finds of the species in the region [Zagorodniuk 2025]. Information is also provided on finds of the species in the Rostov region, from where, as shown below, the expansion began.

All cadastral records begin with an abbreviated form that includes the cluster code, the serial number of the find, the key locality and the year, for example: 'D2. Melekine 2010.' This is followed by detailed information on sites, biotopes, material, dates and so on. For each cluster, the heading specifies the year of the first unambiguous record of a jackal, which determined the order in which the clusters are listed.

A. Rostov Region (first registered in 1997)

In view of the sources of its expansion, we shall begin our review of jackal records from the Don region, from where, in the author's opinion, the species expanded into the eastern part of Ukraine, specifically the Donetsk Ridge and the Azov region. It is clear that jackals are found in many locations across the North Caucasus, and the growth in their population has been analysed on numerous occasions [e.g., Bakeev 1976; Gineev 2019]. Therefore, this paper focuses solely on records of jackals in the regions of Rostov Oblast closest to Ukraine, primarily in the Lower Don region. Most of these sightings have been sourced from hunting forums.

Most records date from after 2010, whilst media sources citing the 'Regional Ministry of Natural Resources and Ecology' indicate that the species only appeared in Rostov Oblast in 2005 (see the entry 'Taganrog 2012'). If we take into account the earlier appearance of the jackal (2001/2002) on Tuzla (Taman Peninsula) and the first two records in the register—from 1997 in the Mius Delta (Nataliivka) and 1999 on the Manychi (Kazachy farm)—, then claims of the 'first appearance of the jackal' in Rostov Oblast in 2005 must be rejected. In this case, the main hypothesis is that the jackal penetrated south-eastern Ukraine from the Ciscaucasia region via the Mius Estuary (Taganrog Raion) and then along the Mius through Snizhne and further to the Donetsk Ridge. Actually, this route explains the jackal's early appearance in the Ridge and the fact that it was there that the oldest finds for eastern Ukraine as a whole were made.

*A1. Nataliivka 1997. Near Nataliivka, Taganrog Raion, valley of the Mius River; 'we went hunting for feathers, and local hunters talked confidently about jackals', autumn 1997 (V. Sirenko, pers. comm.).

*A2. Kazachii 1999. Near Kazachii, Veselivsky Raion, Rostov Oblast, 1999 (O. Trunov, pers. comm., in: [Zagorodniuk 2006: 233]).

A3. Taganrog 2012. Near Taganrog and some districts of Rostov Oblast: 'In 2012, the number of recorded jackals [in the region] was just under 200; by 2016, the count had increased sixfold.' (Media report dated 21 October 2016: URL); the same + 'they only appeared here [in the region] in 2005' (publication 19 October 2016 in the media: URL).

A4. Sinyavske 2015. Neklinovsky Raion, Rostov Oblast, 'They're in the floodplains. ... Tanais, Sinyavka ... etc.' Post dated 08/11/2015 (fishing and hunting forum: donfisher).

A5. Tanais 2015. Near Nedvigovka, Myasnikovsky Raion, Rostov Oblast: 'they are in the floodplains. ... Tanais, Siniavka ... etc.', entry dated 8 November 2015 (ibid.).

A6. Rogozhkino 2015. Rostov Oblast: 'Today in Rogozhkino, at five in the morning, a pack came within a

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hundred metres of the boat. They howled for a long time. And in winter, packs are already running around near the house,' entry dated 08/11/2015 (ibid.).

A7. Novomoiseevsky 2018. Rostov Oblast, left bank of the Lower Don, Novomoiseevsky, Proletarsky Raion (47.157220, 41.138610), 'Bolshaya Sadkovka ravine', 2018: rabies was detected in a jackal caught in the ravine on the Taiwan Peninsula, 8 km of the farmstead [PIK 2018].

A8. Kireevka 2024. Kireevka, north-east of Shakhty, Rostov Oblast: 'This morning, the farmer discovered three dead sheep, and a hole had been cut in the protective fence. Jackals howled in the area all night long.', 3 February 2024 (media sources: URL).

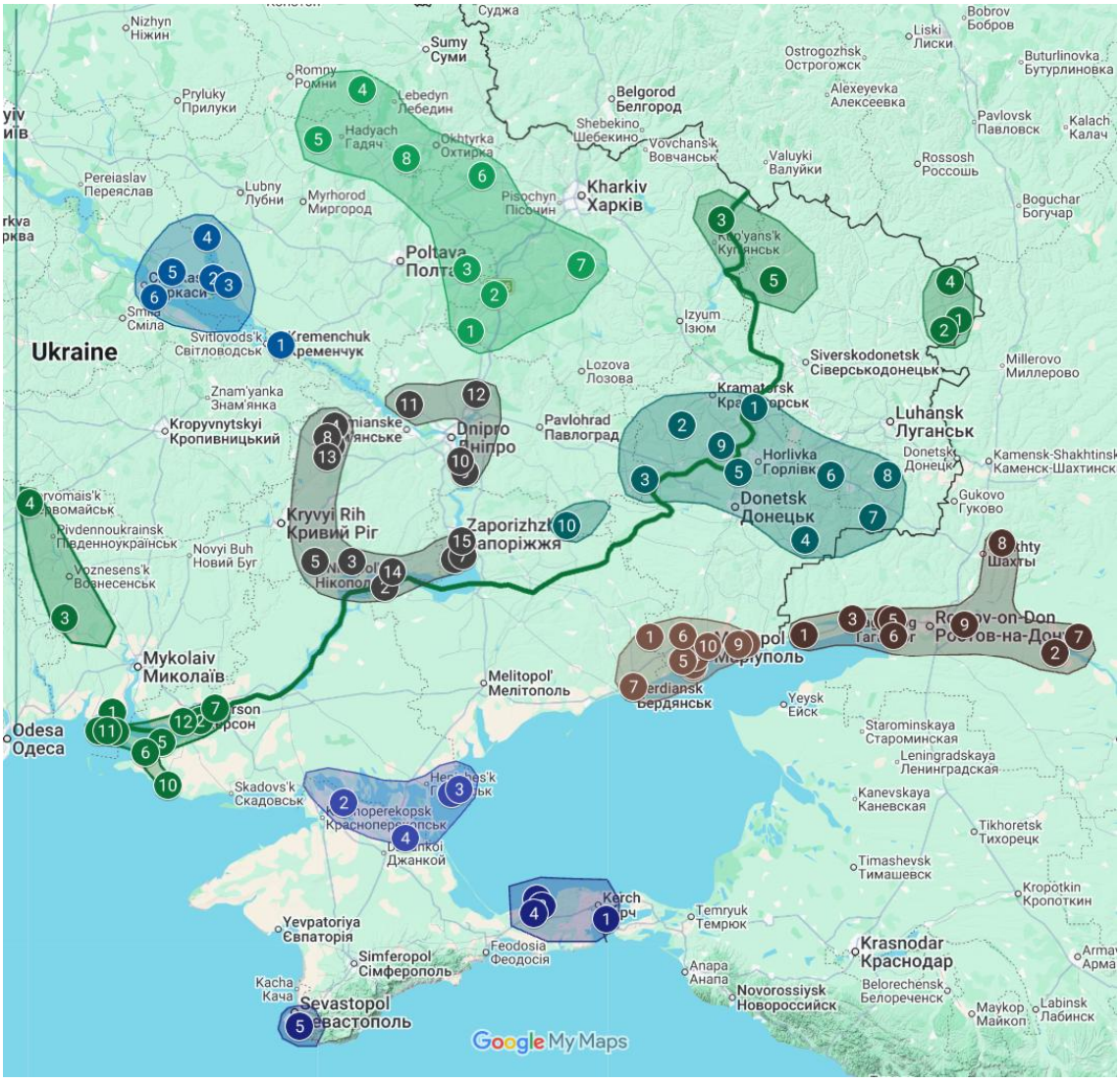

Fig. 2. Location of the jackal's habitats on the map covering the occupation and war zones. The grey line is the frontline as of the end of 2025. Descriptions of the jackal's locations are provided in the text. The locations within each cluster are numbered in the order in which they were recorded, making the map easier to read and helping to understand the species' distribution patterns.

Рис. 2. Положення місцезнаходжень шакала на мапі, що охоплює зони окупації та бойових дій. Сіра лінія — лінія фронту станом на кінець 2025 р. Описи місезнаходжень шакла представлено у тексті. Точки в межах кожного кластера нумеровано відповідно до хронології їх виявлення, що полегшує читання карти і розуміння динаміки розселення виду.

B. Donetsk Ridge (first registered in 2003)

*B1a. Bakhmut 2003. Bakhmut (Artemivsk) Raion, Donetsk Oblast, no further details[3], [early] 2003 [Volokh 2003]; clarification from the author (A. Volokh, pers. comm.): '01.02.2003, blackthorn thickets, 1 specimen (♂) harvested, reported by L. Taranenko; based on a photograph from the newspaper 'Hunting and Fishing' 2003[4];

*B1b. Bakhmut 2003. Bakhmut (Artemivsk) Raion, without details, 2003, forest, 2 specimens harvested) (A. Volokh, pers. comm. [source unclear; possibly exactly the same as 'B1a'].

*B1c. Paraskoviivka 2003. Bakhmut Raion, Donetsk Oblast, no details ('From the lowlands of the Don, a few migrants have penetrated the fields'), 2003 [Volokh 2003].

*B2. Hruzke 2005. Near Hruzke, Pokrovsk (Kostiantynivka) Raion, Donetsk Oblast, year unknown; listed in the inventory of finds for 2005–2013 according to H. Molodan and V. Ugnevenko[5] [Volokh 2014]; clarification from the author (A. Volokh, pers. comm.): December 2005, farmland, 3 specimens, mousing, report from the head of the Dobropilllia branch of the UHFS.

*B3. Dobropillia. Near Novo-Mykolaivka, Pokrovsk Raion, Dnipropetrovsk Oblast (48.188056°, 36.921667°, Solona River), without details, 'in 2005–2013' [Volokh 2014]; clarification from the author of the note (A. Volokh, pers. comm.): December 2005, reeds, 1 specimen, flushed out whilst hunting foxes, report from the head of the Dobropilllia branch of the UHFS.

*B4. Amvrosiivka. Amvrosiivka Raion, Donetsk Oblast (without details), year unknown, listed among finds from 2005–2013 [Volokh 2014]; clarification from the author (A. Volokh, pers. comm.): 2006 (without details); meadow in the floodplain, 1 specimen (without details, harvested?).

B5. Novobakhmutivka 2011. Between Novobakhmutivka and Verkhniotoretske, Donetsk Oblast (10–15 km east of the Donetsk–Kostiantynivka road); observation and photographic record of a group of three individuals, 26 May 2011 (photo by D. Pylypenko: Fig. 1*a*).

B6. Industria 2012. Donetsk Ridge. Near Industria, Rovenky Raion, Luhansk Oblast, 48.218778°, 38.743167°, 30 April 2012, a specimen with hybrid characteristics found as roadkill, found by O. Martynov, pers. comm. (photo on Fig. 1c).

B7a. Diakove 2018. Near Diakove, Antratsyt Raion, Luhansk Oblast, 2018, 1 spec. found in a hunting snare, shot dead, mounted; reported by V. Vetrov and S. Lytvynenko.

B7b. Diakove. Diakove, Antratsyt Raion, Luhansk Oblast, 47.969481 39.131192, 2 October 2019, 1 spec. harvested, by V. Prosalov (https://ok.ru/group/, via D. Lazariev).

B8. Makedonivka 2019. On the Kamianka River (between Rovenky and Makedonivka), early 2019, 'found by fellow hunters', reported by S. Lytvynenko.

B9. Kleban-Byk 2021. Oleksandro-Kalynove, Donetsk Oblast (near the Kleban-Byk National Park office), May 2021, twice near a pig carcass, in a ravine by the road (A. Zuyakov, according to information from the national park service).

B10. Bratske 2022. Near Bratske, Pokrovske District, Dnipropetrovsk Oblast, in a farmfield near an apiary, a couple of jackals were spotted and filmed, 6.08.2022 [Zagorodniuk & Rott 2025].

C. Syvash Raion (first registered in 2003)

A survey in 2000 revealed the species' absence from the Syvash Lakes region [Dulitsky *et al.* 2000], which attests to its rapid subsequent expansion: within just a couple of years, the species was being recorded there regularly. By comparison, records from the Lower Dnipro (Group G) occurred much later, with a distinct 'wave' of records around 2010–2011 [Volokh & Shestopal 2011]. Most likely, the first jackals in this region were recorded on Byriuchiy Island—their appearance here is thought to date back to the winter of 2001/2002, whilst unambiguous findings are reported for 2004–2008 [Domnich *et al.* 2009]. This makes possible to trace the appearance of the species in the region along the 'Byriuchiy → Syvash → Lower Dnipro' chain and, furthermore, to recognise the settlements

[3] The text is accompanied by the phrase 'Some migrants from the Lower Don region have entered the farmland [...] of the raion, which is not supported by markings or other means of tracking and may therefore be a mere supposition.

[4] No articles on jackals or hunting in Bakhmut (Artemivsk) Raion were found in the 2003 issues (search conducted with the assistance of the editor of this newspaper, S. Synchuk).

[5] Gennadiy Molodan at that time was the director of the Meotida National Nature Park; Valeriy Ugnevchenko was the chief gamekeeper of Donetsk Oblast.

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south of the Syvash Lakes (in Crimea proper) as having originated from them, specifically in Mysove, Pisochne, and their surrounding areas at the base of the Kerch Peninsula, on the Azov sea side (see below).

*C1. Biryuchiy 2003. Zaporizhzhia Oblast, Azov-Syvash National Park, Byriuchiy Island spit; several records: 'the jackal invasion of the island took place in the winter of 2001/2002 [no evidence], howling near the Sadky border' (2003); 'breeding burrows in 2004–2008'; '3–7 individuals were recorded in group howls of jackals in 2007' [Domnich *et al.* 2009].

*C2. Syvash 2005. From the Crimean side, the Syvash region eastwards to Dzhankoy, regular reports from locals of direct observations, footprints and vocalisations over the 'last 20 years' [taken to mean 2005–2025] (I. Evstafiev, pers. comm.); marked on the map as a single point to denote the area.

*C3. Byriuchiy 2007. 'In 2007–2008, adult animals and juveniles... were recorded by their footprints near watering holes and on damp slopes in the central, western and northern parts of the island. In 2009, an adult female jackal with one pup was visually observed in the area of Olen Bay [Domnich *et al.* 2009].

C4. Chaikine 2010. The Syvash marshes near Chaikine; in the floodplains, around 2010 ('about 15 years ago'), local hunters encountered and heard calls there on several occasions (I. Evstafiev, pers. comm.).

D. Starobilsk and Derkul River regions (first registered in 2006)

This is where one of the earliest records of the species in eastern Ukraine comes from: in the second half of 2006, a student of the author, together with other hunters, closely observed an unknown pair of animals whose behaviour and morphology corresponded to the image of a jackal [Zagorodniuk 2006]. This record was consistent with records of jackals in the Kriazh in 2003–2005 (cluster B), which were unknown to the author at the time. Later, the species was not recorded there until the end of 2020, as reported by a local hunting expert (O. Melezhyk, pers. comm.). The following findings (with photos) were recorded only between 2021 and 2025. Then, in the autumn of 2021, the species was recorded in Kupiansk Raion (Kharkiv Oblast) and, in 2024, in Svatove (Luhansk Oblast).

*D1. Kornosove 2006. Milove Raion, Luhansk Oblast, 'Hunters' sightings of jackals in August and November 2006 near the village of Kornosove, Milove Raion' (O. Pasichnyk, pers. comm.) [Zagorodniuk 2006].

D2. Baranivka 2021. Baranivka, Bilovodskyi Raion, Luhansk Oblast, 49.15387, 39.83831, 2021—one specimen obtained; 18–19 January 2025—a hunt for a flock of 6–7 individuals, one captured (photo in Fig. 1, *i*) (data from local hunters).

D3. Dvorichanska, 2021. Kupianskyi Raion, Kharkiv Oblast, hunting grounds of the Dvorichanska branch of the UTMR, November 2021, 1 specimen hunted, according to the State Service for Food Safety (…) in Kharkiv Oblast: 'Hunters have bagged a jackal in Kharkiv Oblast' (URL).

D4. Morozivka 2024. Morozivka, Milove Raion, Luhansk Oblast, 49.46238, 39.89673, 2024, one specimen harvested (data from local hunters, via colleagues from Luhansk Oblast).

D5. Svatove 2024. Svatove Raion, Luhansk Oblast, 5 specimens (two raions mentioned: 'A jackal has appeared. A video was shared, apparently from the Bilokurakine Raion, but it's actually the Svatove Raion. Five of them, probably a litter'); post on a hunters' forum (https://uoor.com.ua).

E. Northern Azov Region (first recorded in 2007)

The earliest records come from the northern part of the cluster, the latest from the south-east (from where the species is believed to have migrated). In those years, intensive research in Meotida did not allow it to be recorded at least by 2008 (V. Timoshenkov, pers. comm.); the species is also not mentioned in the 2010 summary 'Fauna of the Meotida Regional Landscape Park' [Bronskov *et al.* 2010]. From Rostov Oblast (in particular, near Taganrog), the species appeared no earlier than 2012 (in the region as a whole—2005: URL). It can therefore be assumed that the species came to the Azov region from the north, from the Kryazh, where it was already known in 2003–2006 (and in the north-east of Luhansk Oblast from 2006 as well [Zagorodniuk 2006]).

*E1. Polovtsian Steppe 2007. Donetsk Oblast, Nikolsky ('Volodarsky') Raion, Polovtsian Steppe Regional Landscape Park (47.3175°, 37.152222°), no data ('in 2005–2013, reports from G. Molodana and V. Ugne-

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venko') [Volokh 2014]; clarification from the author (A. Volokh, pers. comm.): 2007 (no details), farm field, 1 individual, walked across the field, observed from a car window, reported by G. Molodan), therefore we accept the first record as '2007'.

E2. Melekine 2010. Near Melekine, Donetsk Oblast. 'The first jackals came to us across the frozen sea in Melekine around 2010–2011 from Kuban. We shot up to five of them over the winter.' Reported by V. Sagarytsia, director of the 'Udacha' forestry enterprise [Khizhnikova 2020].

E3. Buryakova Balka 2011. Buriakova Balka, Mangushsky ('Pershotravnevy') Raion, Donetsk Oblast, November 2012: during a pre-commercial survey, hunters bagged two specimens ('Stray jackals'; website 'Novosti Donetska' don-news.net, 19 November 2012). Information on Pershotravnevy Raion without details is available here: [Волох 2014: 'oral reports by G. Molodan and V. Ugnevenko'].

E4. Mariupol 2013. 5 km south-west of Mariupol, dead (shot), letter from O. Bronskov, 8 October 2015; from approximately the same location, there is a jackal specimen in the museum of Donetsk National University, caught by hunters in 2013, O. Bronskov, pers. comm. (photo in Fig. 1) [Zagorodniuk 2014].

E5. Mangush 2015. Meotida National Park, Mangush Raion, Donetsk Oblast. 'In 2015, a jackal was recorded in Mangush Raion for the first time' [Nepsha & Shamrytska 2019: 62].

E6. Lisne 2020. Lisne, Nikolsky Raion, Donetsk Oblast, 'Pryazovske Forestry', 2020 (?), 'today their numbers have far exceeded a hundred', according to V. Sagarytsia, director of the 'Udacha' forestry [Khizhnikova 2020].

E7. Novovasylivka 2020. Novovasylivka, Berdiansk Raion (nearby to the Pryazovsk National Park), 46.83117°, 35.75124°, the video shows wide floodplains in the vicinity, summer 2020, attacks on domestic animals almost every day, 3 specimens shot after attacks on goat kids and chickens at farmsteads ('Jackals have begun attacking Berdiansk Raion', TV5 'Zaporizhzhia News'), 26 April 2021. URL).

E8–E9. Bezymenne and Shyrokyne 2020. Near Bezymenne, Novoazovsk Raion, a large red specimen was killed on 17 November 2020 near the village (Fig. 1 *f*); 'according to hunters, there are many such animals; they live in packs of about 10 individuals and inhabit burrows near Shyrokyne' (V. Martynov, pers. comm., 23 November 2020); the find was published by the cited authors [Martynov & Nikulina 2021].

E10. Mariupol 2022. Mariupol, city area, market, municipal enterprise 'Happy Animals', 31 January 2022, rabies confirmed [Gulyayev 2022].

F. Middle Dnipro Region (southern part) (first recorded in 2008)

The area covers two administrative regions—Dnipropetrovsk and Zaporizhzhia oblasts—which have been inhabited by jackals since 2008, predominantly or almost exclusively along the Dnipro floodplain and the lower reaches of its tributaries, in particular the right-bank Saksagan and Kamianka, and in the east (left bank)—the Samara and Orel. In Dnipropetrovsk Oblast, the main data were obtained from the media and from game experts R. Onufriyev (†2024, based on his accounts and with the assistance of O. Ponomarenko) and O. Stetsko (with the assistance of P. Chegorka). In total, the cluster comprises 15 sites. Based on the distribution of finds and their chronologies, the entire data set is divided on the map into two groups—the south-western (2008–2019 and new finds from 2023–2025) and the clearly later-formed north-eastern (2019–2023, locations F9–F12).

In the east of the region, there are two sites isolated from finds near the Dnipro River—at Dobropillia (2005) and Bratske (2022), both in Pokrovsk Raion of Donetsk Oblast (see the description of cluster 'B' regarding the Donetsk Ridge). In Dnipropetrovsk Oblast, according to local game experts, jackals first appeared as recently as 2015, and in 2018 '6–8 jackals were recorded, though this number is underestimated'[6]. Given the dates of the animal's appearance here, this cluster is distinct from the more easterly one located on the Ridge, though its formation may well have originated from the Ridge itself, although it cannot be ruled out that it was colonised by immigrants from the Syvash region (yet the lack of information regarding the Molochna River, along which settlement might have taken place, is curious). The known jackal records in other neighbouring clusters are dated significantly later, particularly in the Lower Dnipro region (the earliest dating from 2011), so migration from there is not considered.

[6] Media interview with O. Oliinyk, Head of the Hunting Sector at the Dnipropetrovsk Forestry and Hunting Administration: 'most-dnepr.info', 23 November 2019 (URL).

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*F1. Krutoyarivske 2008. Near Zaporizhzhia, between the villages of Kanivske and Lysogirka, Krutoyarivske Forest District, 2008, 1 specimen harvested by hunters [Volokh & Shestopal 2011].

F2. Kamianka-Dniprovska 2012. Kamianka-Dniprovska, Zaporizhzhia Oblast, 'We killed such an animal that year [= 2012], mistaking it for a wolf, as they looked exactly alike!', post dated 19 December 2013 (hunter 'Zveroboi_№1', UTMR forum, URL).

F3. Pokrov 2014. Near Pokrov (formerly Ordzhonikidze), Nikopol Raion; two jackals were shot during a hunt, late 2014 (reported by O. Stetsko via P. Chegorka).

F4. Komisarivskyi Forest 2016. Komisarivskyi Forest Nature Reserve, Piatykhatskyi Raion, Dnipropetrovsk Oblast, 48.537222°, 33.916667°, '2–3 years ago' (~2016–2017), jackals were shot in Piatykhatsky Raion, but there were only solitary individuals there (R. Onufriev, pers. comm.).

F5. Apostolove 2016. Near Apostolove, Apostolove Raion, Dnipropetrovsk Oblast, 2–3 years ago (~2016–2017), shot, solitary individuals, and 'now' (recorded in 2019) there are large packs of them (R. Onufriev, pers. comm.).

F6. Terno-Lozuvatka 2017. Outskirts of Terno-Lozuvatka, Dnipropetrovsk Oblast, near the reeds, a jackal was caught in a trap by a professional trapper; data from local hunters (O. Stetsko, via P. Chegorka).

F7. Bila Hryada 2018. Zaporizhzhia, the strait between the Dnipro and Kushuhum rivers, the 'Bila Hryada archipelago' (one year prior to Terioshkola-2019 conference), around 15 individuals had been harvested the previous year (information from a local hunting expert invited to Terioshkola).

F8. Lozuvatka 2019. Dnipropetrovsk Oblast; in May 2019, a pair of jackals was observed between the villages of Lozuvatka and Komisarivka; in the summer, a female with two pups was seen drinking water from a spring in the same area (observation by O. Stetsko, via P. Chegorka).

F9. Zvonetske 2019. Zvonetske, Dniprovskyi Raion, Dnipropetrovsk Oblast, along the Dnipro River, 2019, 'they roam in packs, one was lying on the verge of a steppe road' (photo in Fig. 1, 03.10.2019) (R. Onufriev, pers. comm) ; F9a (likely the same): Solonyanskyi Raion, Dnipropetrovsk Oblast, 'in the region's forests' (no details), 7 individuals recorded, one shot by hunters, reported by local ecologist D. Kulybaba on 21 October 2019 [Vykhrystenko 2019].

F10. Voloske 2020. Voloske, Dniprovskyi Raion, Dnipropetrovsk Oblast, 1 June 2020: 'In recent days, jackals have entered the grounds of a private residence in the village of Voloske, where they attacked domestic rabbits', media reports [Zhuravel 2020].

F11. Petrykivka 2020. Petrykivka Fish Farm (on the Orel River), Petrykivka Raion, Dnipropetrovsk Oblast, c. 2020 and later (O. Nastachenko via P. Chegorka, pers. comm.).

F12. Vilne 2023. Vilne, Novomoskovsk Raion, Dnipropetrovsk Oblast, 26 December 2023, 1 specimen shot after rabies vaccination of predators (article 'Beware, jackals and bats are all around us' on the 'Novomoskovsk City Council' website: URL).

F13. Saksagan 2023. Dnipropetrovsk Oblast, three jackals were shot near the village of Saksagan during the autumn hunt for predators; there were six specimens in total (O. Stetsko, via P. Chegorka).

F14. Nikopol 2025. Nikopol Raion, Dnipropetrovsk Oblast, the bed of the former Kakhovka Reservoir, 'areas freed up after the water receded quickly became overgrown with reeds and shrubs', 2025 (URL).

F15. Khortytsia 2025. Khortytsia Island, Zaporizhzhia Oblast, observation with photo documentation on the shore, 9 August 2025, with a note that 'ecologists had known about the presence of jackals in this area for 20 years—they were recognised by their characteristic howling' (URL), yet as of 2019 (Terioshkola on Khortytsia), neither local zoologists nor reserve staff were aware of this.

G. Lower Dnipro (first recorded in 2010)

On the Lower Dnipro, particularly in the area of the Black Sea Biosphere Reserve (BSBR), the species was recorded between 2010 and 2016, notably near Ochakiv in 2010–2015, in the Krynka area from 2011, and on the Bug River upstream (Veselynove and Myhiia) in 2011–2016. Compared with neighbouring clusters, the species appeared here relatively late, meaning that the area was not a forward outpost for its expansion. In the BSBR area, the main records began only in 2018–2019 (details below): a total of nine sightings are known from here, including three on the right bank of the Dnipro, three on the tip of Kinburn in the vicinity of Svyatoslav's White Coast National Park[7], and three from

[7] Data from the 'Chronicle of Nature' and the report on the research topic 'Monitoring the state of natural complexes in the Black Sea Biosphere Reserve (Chronicle of Nature)' for 2016–2020, state registration number 0116U003374.

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various parts of the BSBR itself. According to data from early 2022, there were no jackals on the Dzharylgach Peninsula [Sheihas 2023], where conditions are favourable for them (floodplains, wildlife). Numerous jackal sightings near Ochakiv in 2010–2015 (a total of 8 locations along the eastern coast of the Dnipro–Bug Estuary below Ochakiv) are documented in K. Redinov's article [Redinov 2015]; here they are listed as a single (first) record.

G1. Ochakiv 2010. Kherson Oblast, left bank of the Dnipro–Bug Estuary, mainly in the section from Ochakiv to Parutine; a series of finds between 2010 and 2015 [Redinov 2015].

G2. Krynka 2011. Oleshky ('Tsyrupynsky') Forestry Enterprise, Kherson Oblast, 11th quarter of the Krynka Forest District, an island in the Dnipro floodplain (hunting grounds of the 'Ecofilter' NGO), 46.603576, 32.603805, 1 specimen recorded on 14 August 2011 by camera trap, collected on 22 August 2011 [Volokh & Shestopal 2011][8].

G3. Veselynove, 2011. Veselynivskyi Raion, Mykolaiv Oblast, hunting reports, 15 November 2011, forum of the UTMR (https://uoor.com.ua/): a precise description of a jackal, with a photo, but no one expected or knew so the respondent (Georg-Evgen) was 'downvoted' (URL).

G4. Myhiya 2016. Near Myhiya, Mykolaiv Oblast, Bug floodplain; direct observation of a pack of about 5 individuals on a road in riverside scrub, summer 2016 (A. Andrusenko, pers. comm.).

G5–G6. Black Sea Nature Reserve 2018. Hola Prystan Raion, Kherson Oblast: (G5) 2018, village of Rybaltche, (G6) village of Ivanivka, Yagorlytska Bay, 2019 (Z. Selyunina, pers. comm.).

G7. Antonivka 2019. East of Antonivka, Mykolaiv Oblast, right bank of the Dnipro, 2019 (Z. Seliunina, pers. comm.).

G8–G10. Kinburn 2019. Ochakiv Raion, Mykolaiv Oblast, left bank of the Dnipro Estuary, base of the Kinburn Spit: (G8) near the village of Pokrovske, 2019; (G9) near the village of Vasylivka, coast of the estuary, 2019; (G10) Kinburn, between the villages Pokrovske and Vasylivka, 2020, data from gamekeepers and hunters (Z. Selyunina, pers. comm.). For Kinburn, it was subsequently noted that 'in recent years, the jackal population has increased; these predators actively prey on both birds and chicks', 2024 review [Strilets 2024].

G11. Novofedorivka 2020. Novofedorivka, near the town of Zaliznyi Port, Hola Prystan Raion, Kherson Oblast, 2020 (Z. Selyunina, pers. comm.).

G12. Bilozerka 2020. Bilozerka, Mykolaiv Oblast, right bank of the Dnipro, 2020, information from a guard at the Bilozerka orchards (Z. Selyunina, pers. comm.).

H. Slobozhanshchyna (first recorded in 2012)

In north-eastern Ukraine, the area of primary distribution has a distinctive configuration, which could be described as the headwaters of the Dnipro's left tributaries—the Orel, Psel, Vorskla, and Sula—which flow from the south-western spurs of the Central Russian (Left-Bank) Upland. Jackal records here are among the latest for the left bank. The very first were recorded in 2012–2013 in Poltava Oblast [Volokh 2014], followed by records in 2017 and subsequent years in Sumy and Kharkiv oblasts. In general, the sightings of jackals in this region in 2012–2013 almost surely exclude their association with the nearest areas of the Dnipro region, where the species obviously appeared later, although they are geographically and chronologically closer to the records from the Donetsk Ridge, the first of which occurred in 2003–2005 and originate from the vicinity of Paraskoviivka (near Bakhmut), Hruzke, and Dobropillia; all these locations are situated in the north-east of Donetsk Oblast.

H1–H3. Somivka 2012. Poltava Oblast, three locations that approximately correspond to three district centres—Somivka (2012), Berestyn (2012), and Varvarivka (2013) (according to the map in: [Volokh 2014]; place names are not specified in the original).

H4. Vasylivka 2017. Tyrka tract near Vasylivka, former Lebedyn Raion, Sumy Oblast (5 km from the Mykhailivska Tsilyna Nature Reserve), 20 January 2017, observation of two adult jackals, one of which was captured during a hunt (data from gamekeeper O. Kaidash); previously, the same hunters had recorded 'wolf-dog hybrids' in the same area, which were almost certainly also 'common' jackals [Merzlikin 2025: 73].

H5. Zabrid 2021. Near Mala Obukhivka, Hadyach Raion, Poltava Oblast; Bezvidnyanske Forestry, in the

[8] Maksym Shestopal — Director of the hunting estate at NVO 'Ecofilter' LLC.

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valley of the Psel River, the Zabrid tract, 50.351111°, 33.751944°, sightings and tracks, flushed out of the reeds, 12 January 2021 Zabrid, 50.351111°, 33.751944°, sightings and tracks, driven out of the reeds, Dec 2021, according to local game experts (S. Lytvynenko, pers. comm.).

H6. Huty 2022. Bohodukhiv Raion, Kharkiv Oblast, hunting grounds, ~10 individuals recorded before the war (2022), 44 in 2024 (video report from the hunting grounds URL).

H7. Homilsha 2023. Zmiiv Raion, Kharkiv Oblast, Homilsha Wood National Nature Park, 1 km north from village of Haidary, 02.2023, traces at a watering hole (observed by a security guard; V. Timoshenkov, pers. comm.).

H8. Hrun 2025. Near Hrun, Okhtyrka Raion, Sumy Oblast, Hetman National Nature Park, 9 March 2025, sighting at dusk 20 m from the car on the road near a ravine overgrown with bushes; data from a gamekeeper [Merzlikin 2025: 73].

I. Middle Dnipro Region 1 (Upper) (first recorded in 2016)

This cluster covers the territories of Poltava and Cherkasy oblasts, and partly also Sumy Oblast. The number of records here is relatively small (7), and all of them are recent, dating from 2020 to 2023. The only exception is a 'record' from 2004 in Kremenchuk, analysed in detail in a previous review [Zagorodniuk 2025]. The analysis indicates that this early record was fake, created for the sake of a 'eureka' effect and the novelty value of the study, and all available facts contradict it (it is therefore listed here with the designation {Fantom}).

All these records near the Kremenchuk Reservoir are most probably the result of dispersal from the Slobozhanshchyna cluster, particularly from Poltava Oblast (the Orel basin, including the Orchyk and Berestova rivers), where the species had already been known in 2012–2017, or from the adjacent southern districts of Dnipropetrovsk Oblast (in Piatykhatky Raion the species was recorded already in 2016–2017; see point F4). Counter-dispersal of the species from both directions cannot be excluded. In any case, this entire cluster is generally the most recently formed among all the others considered here. It was formed approximately in the same period as the adjacent northernmost fragments of the range considered here (see Fig. 2), the 'Sumy' and 'Kharkiv' clusters.

*I1 {Fantom}. Kremenchuk 2004. Poltava Oblast, floodplain of the Dnipro River in the vicinity of Kremenchuk, the Biletskivski Plavni Reserve (to the right of the main Dnipro channel), 49.06278°, 33.3875°, visual observations and tracks of jackals from 11 November 2004 to 6 March 2005; on the latter date, 21 individuals were allegedly counted by snow tracking [Ruzhilenko *et al.* 2011]. A detailed analysis of these data showed that they were fictitious, apparently 'generated' to produce a desired novelty effect [Zagorodniuk 2025]; nevertheless, jackals actually appeared in the area 7–10 years later.

I2. Lypove 2020. Lypove, Kremenchuk Raion, Poltava Oblast, Kremenchuk Forestry Enterprise, islands in the mouth area of the Sula River, 49.482222°, 32.7275°, numerous observations, animals harvested in autumn 2020 (URL: video report dated 02.02.2021).

I3. Sviatylivka 2020. Between the villages of Sviatylivka and Buhaiivka, Kremenchuk Raion, Poltava Oblast, three specimens harvested by local hunters at abandoned fish-breeding ponds in 2020 (M. Klestov, pers. comm.).

I4. Orzhytsia 2021. Lubny Raion, Poltava Oblast, Nyzhnosulskyi National Nature Park; according to Volume X of the 'Chronicle of Nature' for 2021: '77 animal species new to the territory were recorded. Among vertebrates: [...] the golden jackal' [Regional... 2022: 156]; additionally, jackals were heard and observed hunting roe deer within the park in winter 2021 (M. Klestov, pers. comm.).

I5. Irkliiv 2022. Near Irkliiv, Zolotonosha Raion, Cherkasy Oblast, harvested in spring 2022 (exact date not reported) (M. Klestov, pers. comm.; photo in Fig. 1*k*).

I6. Cherkasy 2023. Outskirts of Cherkasy, harvested (or found dead?), photographic evidence from local residents, spring 2023, communicated by P. Voitko (photo in Fig. 1).

J. Kerch Peninsula (first recorded in 2018) + Sevastopol

A stable population formed in the Syvash area (see above, 2002–2022) and in the Astaninski Plavni wetlands (this section, 2018–2022), i.e. on the north-eastern side of Crimea, where extensive shallow saline marshes occur. Judging by the chronological gradient of records, the Astaninski subpopulation should be regarded as one derived from the Syvash population, although with a distinct

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temporal lag of approximately 15 years; however, a latent period of the species' presence in the area, associated with an inconspicuous mode of life, cannot be excluded. In any case, the early record from Tuzla (winter 2001/2002) appears to represent an isolated attempt to penetrate the strait from the Taman side [Volokh 2004], unrelated to the Kerch Peninsula itself and unsuccessful in terms of colonisation. At that time, the jackal was already numerous throughout Krasnodar Krai [Bakeev 1976; Kudaktin *et al.* 2019] and such appearances are therefore entirely expected, but they cannot be regarded as evidence of directed migration towards Crimea.

*J1. Tuzla 2002. Crimea, Kerch Strait, Tuzla Island, appearance on the spit in winter 2001/2002, two individuals, one of which was harvested [Volokh 2004]. The source of the information is unclear; the locality obviously refers not to Crimea itself, but rather to the eastern shores of the Kerch Strait, where the animals could have arrived from the mainland and where they were subsequently harvested. Therefore, there are no grounds for considering this record within the sequence of registrations associated with the expansion process, especially since colonisation of Crimean habitats evidently proceeded from the north [Zagorodniuk 2025].

J2. Azovske 2018. Crimea, 'Mysove' hunting enterprise, two specimens harvested; news item dated to 27 February 2018 (video 'Okhota v Krymu. Shakal' on the YouTube channel 'Okhota-rybalka v Krymu'); same record also referred to as the territory of the 'Mysovske' hunting grounds near Azovske, Lenine Raion; the territory was considered rabies-infected, followed by quarantine measures and culling of animals, 14 March 2019 [Crimea... 2019].

J3. Pisochne 2022. Kerch Peninsula, floodplain meadows on the Azov Sea side (nearby to the villages Pisochne and Ostanine = Astaninski Plavni), animals shot, video from 2022 published by the Crimean Society of Hunters and Fishermen (www.youtube.com).

J4. Vynohradne 2022. Vynohradne, Lenine Raion ('Vynohradnenske' hunting grounds), one individual harvested, 16 June 2022 (website vesti-k.ru, article 'Residents of Lenine Raion terrorised by a jackal').

J5. Sevastopol 2024. Record from the vicinity of Sevastopol and Balaklava Raion, 29 January 2024, two individuals reported (ForPost news service, 5 February 2024: URL); this point is remote from all other known records.

3. Patterns of Distribution

3.1. 'Hidden' Expansion

The situation regarding the species' expansion in Ukraine has its own distinct characteristics. First and foremost, no one expected the species to appear; of several reasons, the main ones being the prolonged absence of specialists on this species, an 'oversight' (in essence, simple ignorance) of publications regarding the situation in neighbouring territories, and the initial misidentification of the first individuals as either dogs, wolf-dog hybrids, or migrant wolves from neighbouring territories.

All three of these aspects are well known to the author. The register above contains examples of how clear-cut jackal findings were dismissed as implausible and/or attributed to hybrids. In eastern Ukraine in the early and mid-2000s, there were frequent reports and tales of 'red Chechen wolves', which the author himself heard on more than one occasion; however, inquisitive hunters claimed that this was 'something else that deserves attention' and shared such sightings. Similar situations occurred in other regions, including Slobozhanshchyna (including Sumy Oblast) and the Middle Dnipro region (in particular, Zaporizhzhia and Dnipropetrovsk Oblasts). It follows that there was a 'silent' phase of expansion, which was essentially overlooked by zoologists [Zagorodniuk 2025]. However, thanks to preserved photographic evidence (the photograph in Fig. 1 and the author's archives) and descriptions, many such finds have been verified and added to the registers.

In general, the initial phase of jackal expansion within Ukraine proceeded largely unnoticed during 1998–2004, and only afterwards did the species begin to be recorded in many localities. The earliest locality in eastern Ukraine was Bakhmut (2003), followed by Dobropillia (2005), Milove (2006), Mariupol and Biryuchyi Island (2007), and from 2010 onwards the Syvash region and subsequently many others. With regard to adjacent territories, it is important to note that early records also exist in the nearest parts of Rostov Oblast, in particular 'A1. Nataliivka 1997' near the mouth of the Mius

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River (Taganrog Raion), where the species was recorded already in autumn 1997, and ‘A2. Kozachyi 1999’ in the Manych area. Similar processes occurred in other parts of the species’ range, including Hungary, where an initial gradual increase in abundance later shifted into exponential growth followed by extensive dispersal [Bijl *et al*. 2024]. In fact, the expansion of the species within Ukraine was preceded by population growth in adjacent regions. It was precisely from those areas that dispersal ‘shoots’ originated, eventually leading to colonisation.

It is important here to note two additional factors underlying this hidden expansion (five in total will be considered below). One of them is the species’ exanthropic character, which in fact results from the circumstance that this colonising species is not truly alien to the region. It had already occurred here in the past (see below) and therefore dispersed by effectively reoccupying its former range (at least in southern Ukraine), primarily through natural or only weakly transformed habitats, thereby avoiding direct contact with humans. This was further facilitated by the fact that even during critical periods the species generally avoids attacks on domestic animals (poultry, sheep, etc.). Another important factor was that the species expanded not as a continuous front, but rather along specific ecological corridors, forming relatively isolated centres (clusters) separated by large gaps, and therefore revealing itself less conspicuously.

3.2. Clusters

As the available data demonstrate, there are distinct clusters of regular records, documented by different colleagues and in different years, contrasting sharply with extensive zones where the species remains entirely unknown. First and foremost, the zones of regular occurrence are floodplain complexes, both near the sea (Biryuchyi Island, the Mariupol region) and within the Dnipro Basin (the regions of the Kakhovka and Kremenchuk reservoirs, and the Lower Dnipro). In these areas, the most attractive habitats to the species are floodplain reedbeds and floodplain shrub complexes, particularly along the gently sloping banks of reservoirs. A separate case is represented by the ridge segment encompassing Kleban-Byk, Dobropillia, and Bakhmut, where probably the earliest wave of expansion took place; this may have been facilitated by the very limited agricultural development of the territory, largely due to its poor suitability for farming. Typical habitats there are broad upland interfluves with shale outcrops, overgrown with shrubs and containing fragments of steppe on hilltops and woodland in ravines (Fig. 3).

Analysis of the distribution map shows that the species occurrence across the Left-bank Ukraine—throughout the entire stretch from the Dnipro almost to the Don—is distinctly clustered. Within the clusters, the records are often relatively dense, forming clearly connected spatial groups. Conversely, there are areas where the species has never appeared and has not been detected despite continuous monitoring and expectations; a notable example is Askania-Nova (I. Polishchuk, pers. comm.), and such areas occur in every oblast. One of the key habitat factors underlying successful expansion and establishment of the species has been the presence of floodplain (reedbed) or upland (shrub) thickets. The former represents especially important habitats, as floodplains provide stable feeding opportunities and shelter (Fig. 4). Considering that eastern Ukraine belongs primarily to the steppe natural zone, floodplains also mitigate microclimatic extremes by providing summer coolness, winter thaws, and access to drinking water.

It is evident that over time, as the population increases, the species will occupy much broader territories and its distribution may eventually become almost continuous. However, in the author’s opinion, the future ‘landscape of abundance’ will continue to correspond largely to the clusters described here, and the clustered structure of the distribution will generally persist, even if somewhat modified.

3.3. The role of wetlands

This habitat type is the principal factor underlying both the species distribution and the formation of clusters. The author is able to analyse only frequencies of occurrence rather than behavioural aspects related to habitat selection and hunting territories; fortunately, these issues have been well described in the literature for the Black Sea region [Rozhenko 2017, 2021], the Azov region [Domnich *et al*.

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2009], and the Fore-Caucasus [Gineev 2019; Kudaktin *et al*. 2019]. Analysis of the cadastral data presented above shows that waterside localities represent the predominant habitat type, regardless of whether these are coastal (and correspondingly brackish-water) biotopes or riverine ones. In all cases, such territories are, among other things, not only weakly transformed by human activity, but also lowland areas characterised by highly unstable snow cover during winter (especially in the south). These territories themselves also have a clustered distribution pattern, which may represent an additional—if not the principal—factor underlying the clustered distribution of the jackal.

Examples of the most notable clusters associated with wetlands are shown in Fig. 4. These are enlarged fragments of the general map presented in Fig. 2, in which the corresponding magnification reveals details of the hydrographic network. In all cases, it is clearly visible that nearly all key localities are waterside habitats situated within large river floodplains, bays of major reservoirs, or along marine coastlines. Naturally, not all groups of localities are of this type, and some of them (see Fig. 2) are clearly associated with upland habitats or with ravine-and-gully systems, especially those situated on the Donetsk Ridge and in Slobozhanshchyna. Nevertheless, any comparison of abundance and other population characteristics between the 'lowland' and 'upland' settlements can only be made with recognition of the obviously higher abundance values in the lowland localities.

Fig. 3. Some habitats where jackals were recorded. Top: various parts of the Donetsk Ridge as a region of probable initial jackal expansion in eastern Ukraine. Photo by the author, 12–29 August 2013; Bottom: reed beds in the Meotyda National Park, the Kryva Split. Photo by M. Kolesnikov, 26–27.07.2008.

Рис. 3. Окремі біотопи, в яких відмічали шакалів. Вгорі — різні ділянки Донецького кряжу як району ймовірно первинної експансії шакала на сході України. Фото автора, 12–29.08.2013; внизу — зарості очеретів у національному парку «Меотида», коса Крива. Фото М. Колеснікова, 26–27.07.2008.

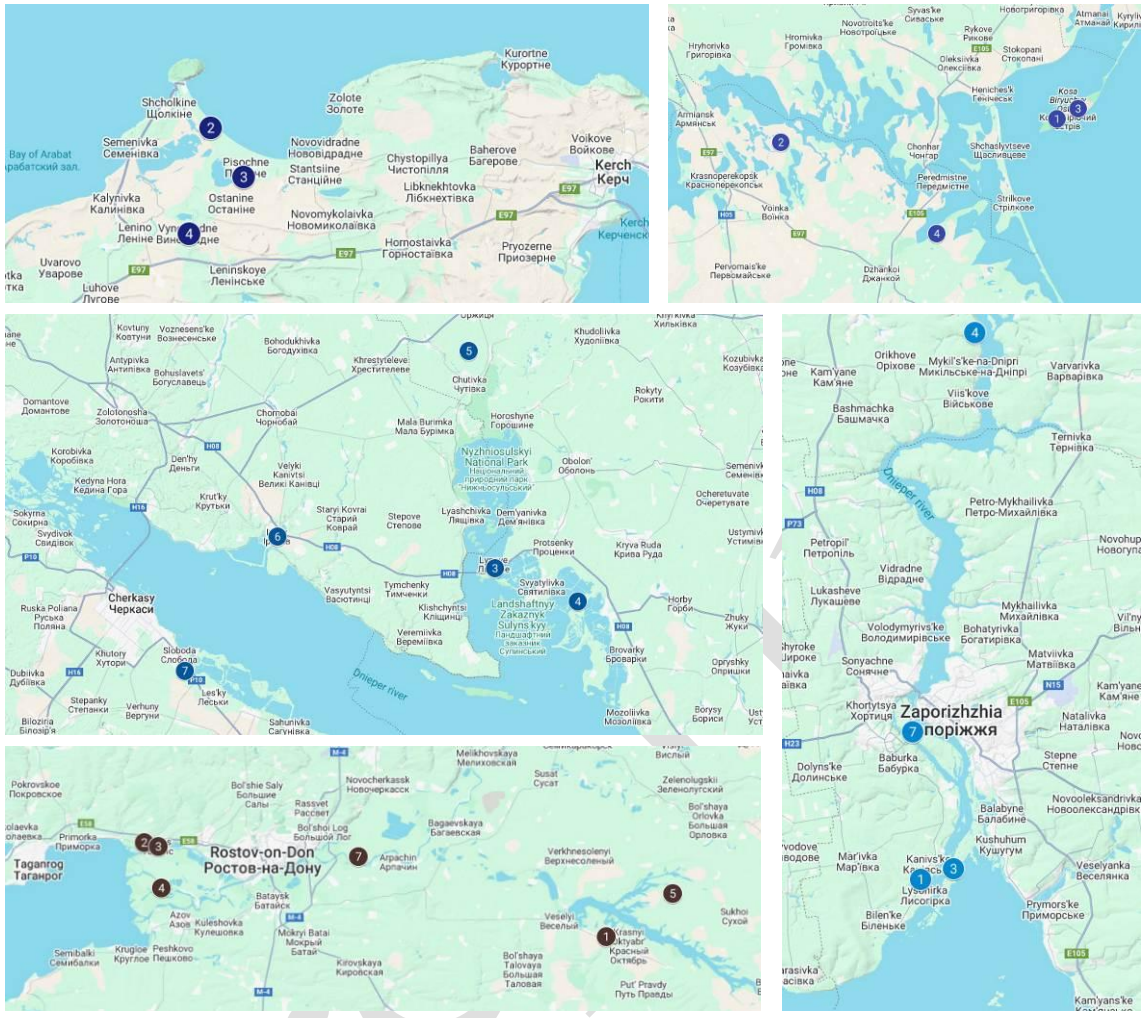

Fig. 4. Areas of concentration of jackal findings near large shallow water bodies (enlarged fragments from Fig. 2): Ostaniane floodplains near Kazantip, Syvash Lakes, and Biryuchiy Island, upper reaches of the Kremenchug Reservoir (including Sulska Bay), the Don lowlands, and the Zaporizhzhia rapids area (including Khortytsia Island).

Рис. 4. Місця концентрації місцезнаходжень шакала біля великих мілководних водойм (збільшені фрагменти з рис. 2): Останінські плавні біля Казантипу, Сиваші та острів Бирючий, верхів'я Кременчуцького вдсх. (вкл. Сульську затоку), низовини Дону, район Запорізьких порогів (вкл. острів Хортицю).

3.4. Floodplains as bridgeheads of expansion

It is evident that the distribution of species depends on the distribution of habitats suitable for them. Here, habitats are understood in the broadest sense—including food availability, shelter conditions, access to water, and related factors. For the jackal, such a combination of conditions is best provided by floodplains, as described in detail for the Ukrainian part of the Black Sea region [Rozhenko 2017, 2021]. Similar descriptions also exist for certain parts of the Azov region, in particular for Biryuchyi Island [Domnich *et al*. 2009]; however, in eastern Ukraine this pattern is clearly expressed only in certain areas, notably (see the cadastre) in the coastal marshes of Crimea and the Berdiansk region, as well as in the floodplains of the Dnipro (Kremenchuk, Bila Hriada, etc.), although numerous records also occur outside floodplain habitats.

Nevertheless, floodplain-type ecosystems (often protected areas) become key centres of the species' occurrence, where it also receives support from conservationists. Such areas currently include, and will continue to include, all coastal biosphere and nature reserves as well as national parks (Biloberezhzhia Sviatoslava, Chornomorskyi, Dzharylhatskyi, Azovo-Syvaskyi, Pryazovskyi, and Meo-

tyda), together with protected areas situated in old river channels and estuaries of major rivers (Nyzhnosulskyi, Velykyi Luh, Orilskyi, Nyzhnodniprovskyi, and Prydintsivska Floodplain). Likewise, the upper reaches of all major reservoirs on the Dnipro and Siverskyi Donets rivers, as well as on smaller rivers (Vovcha, Samara, Oskil, and Kalmius), together with riverside fish-farming facilities, are becoming key centres of occurrence. Artificial waterways also function as ecological corridors of dispersal, including the 'Dnipro–Donbas' and 'Donets–Donbas' canals.

As for the Azov spits, their basal parts often include extensive reedbeds (photo in Fig. 3). The rather high degree of isolation of such areas often results in their relatively late colonisation by jackals. Nevertheless, their overall productivity is high [Tyshchenko *et al*. 2025]. The presence of bird colonies on the spits, together with various 'gifts of the sea' washed ashore and relatively numerous populations of herbivorous mammals (from water voles to wild boars), creates favourable conditions for the establishment and long-term persistence of jackal populations. The same can be said of various bays, river deltas, estuaries, and similar coastal formations.

3.4. Historical notes

When the first publications on the jackal in Ukraine appeared [Volokh *et al.* 1998] and the species was subsequently included in the national fauna list [Zagorodniuk 2001], these facts were still regarded as marginal phenomena with little relevance to the country as a whole. The same situation was repeated in eastern Ukraine, where such findings also appeared highly improbable. However, analysis of the literature has shown that this was not the first appearance of the species within Ukraine. In fact, this represented the third wave of its occurrence.

In particular, Alexander von Nordmann mentioned the jackal in the Odesa region in his 1840 review. The author also possesses a testimony from an elderly resident of the vicinity of the Trokhizbenskyi Steppe Reserve in Slovianoserbsk Raion, Luhansk Oblast, concerning frequent encounters with jackals during the post-war period (1950s onward) (record obtained with assistance from V. Tymoshenkov). Mentions of jackals are also found in the works of Dmytro Yavornytsky on the history of the Zaporizhian Cossacks (the exact period is unclear). Valuable references are likewise present in P. Dziakovich (1900) for the vicinity of Melitopol. Altogether, the following sequence of reports is available, all originating from southern regions, essentially from coastal districts of both the Black Sea and Azov Sea areas:

1. Peter Simon Pallas, like Alexander von Nordmann, mentioned the jackal only from the Don region and the Caucasus [Pallas 1811]. In the review by Nordmann [Nordmann 1840], reference is made to the former occurrence of the jackal in the Black Sea region (Odesa, etc.) and to the 'contemporary' presence of the species farther east (e.g. in the Don). Dmytro Yavornytsky [Evarnytsky 1898] quotes an elderly descendant of the Cossacks who recalled the former abundance of 'wolves, foxes, badgers, wild goats [roe deer], chokalky [jackals], and otters' (possibly referring to the late 18th or early 19th century) [Zagorodniuk 2014].

2. Pavlo Dziakovich [Dziakovich 1900: 16–18], in his essay on Melitopol Uyezd, cites an account by a local resident concerning the nature of the area around the 1830s–1840s: 'there were also saigas and chikalky (jackals) here.'[9]

3. Vicinity of the village of Kriakivka, Slovianoserbsk Raion, Luhansk Oblast: '[after the war, when we lived in dugouts],' approximately from 1943–1945 until 1948–1949, jackals were definitely present but later disappeared; 'many wolves and jackals dug into the dugouts and stole goats.' Information obtained from the elderly agronomist 'Kapitonych' from the hamlet of Vitrivka near Kriakivka; recorded in 2012 (via V. Tymoshenkov).

4. Lower Dnipro region, vicinity of the city of Oleshky, Kherson Oblast, 1950s: reed- and shrub-covered depressions east of the city; direct observation; information from a local respondent [Roman 2019].

5. Former village of Novoukrainka (now abandoned), Chernihivka Raion, Zaporizhzhia Oblast. Jackals were reportedly observed by hunters and tractor drivers during the 1960s–1970s near the Kainkulak River (a tributary of the Tokmak River) within the territory of the abandoned village of Novoukrainka [Kharchuk

[9] The name '*chekalka*' was widespread (an analysis can be found in [Zagorodniuk 2016]), and is evidently very archaic and serves as a source for various languages; in particular, the English '*jachal*' is no less similar to '*chakal/chekal*' than to '*jackal*'.

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& Kharchuk 2015]; clarification: 'The hunters were certain. It was a single observation, in the 1960s.' (S. Kharchuk, pers. comm.).

6. Krasnodar Krai, Kuban River delta: appearance of individual jackals in the delta near the Azov Sea during 1948–1960 [Bakeev 1976]. In addition, 'in 1972 the appearance of the jackal was recorded in the Kuban floodplains near the city of Timashevsk, as well as in the Don River delta' [Volokh 2014: 92, citing pers. comm. from A. Gineev].

As can be seen, jackals have been colonising the area repeatedly in the past, which explains the current expansion of the species. The records cited in this section provide the following chronological sequence: 1830–1840, 1943–1949, 1948–1960, the 1950s, the 1960s–1970s, and 1972.

4. Geographical trends and factors

The expansion of jackals into Ukrainian territory came as a surprise, yet given the population growth observed in neighbouring regions (to the south), it was to be expected. And this process had a clear geographical trend, which coincides with all the key factors developing in the space: global warming, which is shifting current bioclimatic indicators towards those of more southerly regions; the northward shift of the boundaries of biogeographical (natural) zones; the presence of a gradient in the degree of transformation of ecosystems and fauna (disturbances and changes are most pronounced in the south) [Zagorodniuk 2010]. All of these can be identified precisely as factors.

Such influences are sometimes also referred to as 'drivers for expansion' [Bijl *et al*. 2024]. It is worth noting that, by definition, factors contribute to, influence, or limit; whereas drivers provoke [changes], lead [to new states], or promote [actions]. In the case of the jackal, it is most likely that we are referring specifically to factors.

4.1. Some important facts

The sequence in which points appear on the map is of great significance for reconstructions. One of the most important aspects is the analysis of first appearances, as carried out in a previous study [Zagorodniuk 2025]. Such an analysis allows us to identify certain patterns. Thus, the appearance of the species in Crimea should be explained by its migration from the mainland, rather than via the Kerch Strait, as was initially assumed [Roženko & Volokh 2010; Volokh & Shestopal 2011]. In winter, the Kerch Strait is choked with chaotic ice ridges and therefore presents a significant barrier.

Moreover, all records up to and including 2005 are located north of Crimea, on the mainland. The first of these were Bakhmut (2003), followed by Dobropillia (2005), Markivka (2006), Mariupol and Biryuchyi (2007), and Syvash Lake (2010). It is also clear that jackals were present in the Kuban region earlier and spread out from there.

In particular, the jackal has been known to inhabit the North Caucasus for several decades, and a visible population explosion began in 2010, particularly in Krasnodar Krai and Dagestan [Kudaktin *et al.* 2019]. Moreover, 'the annual harvest of more than 2100 animals (25–30% of those recorded) in the Krasnodar Krai does not lead to a noticeable decline in population size' [ibid.: 22]. This population centre, whose dispersal was previously restricted by water barriers (the Azov Sea and the Don River), became the source of a new expansion, which likely occurred in several waves. It was from there that this species penetrated the Northern Azov region, first reaching the Donetsk Ridge (2003–2006) and subsequently the coastal areas (2007–2010).

4.2. General trends

The main map (Fig. 2) was used to analyse trends, supplemented with the dates of the first records of the species in each cluster (Fig. 5). The earliest dates of records are generally unreliable, as they depend not so much on the species' appearance as on the observers' luck. Therefore, the map shows two earliest dates, between which there is often a noticeable gap (2–15 years). If such dates are adjacent, this may indicate the rapid formation of a stable spatial population; if there is a significant gap between them (10–15 years), the first date may indicate the first migrants who did not settled, and only the second date may indicate the start of the formation of a stable population.

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Fig. 5. Geochrones in jackal distribution. Two dates are given—the first and the next one, between which there is often a gap of 2–15 years. The northern clusters (from the Dnipro River to the Donets River), as well as the two southern ones (Lower Dnipro and Kazantip), fall outside the time limits of the first settlements. The oldest ones (known since 2003–2006) are Syvash, North Azov, Kriazh, and Derkul. The illustration is based on the map shown in Fig. 2 and the dates from the register of finds.

Рис. 5. Геохрони у поширенні шакала. Наведено по дві дати — перша і наступна за нею, між якими нерідко є розрив у 2–15 років. Північні кластери (від Дніпра до Дінця), як і два південні (Нижній Дніпро і Казантип), виходять за часові межі перших поселень. Найдавнішими (відомими з 2003–2006 рр.) є Сиваський, Північноазовський, Кряжовий і Деркульський. В основі ілюстрації — карта, наведена на рис. 2, і дати з реєстру знахідок.

It is clear that the oldest clusters are those in the central part—from the Syvash Lakes and the Northern Azov region to the Donetsk Ridge and the Derkul River region (Fig. 5). This is a somewhat unexpected result. If we accept the previously described dynamics as developing from the east [Zagorodniuk 2025], we can hypothesise the migration of the species from the Don region in the broadest sense—either from the Lower Don (from the south of Rostov Oblast) or from the Middle Don (from the north of Rostov Oblast). The simplest explanation is the migration from the southern Rostov Oblast, where isolated finds date to the late 1990s.

4.3. The Mooney effect and disturbed habitats

The jackal does not show synanthropy, which underscores its native status within local faunas and, consequently, the natural cycle of recovery of its range. As it is well known, alien species colonise disturbed habitats [Mooney & Cleland 2001]. In a review of alien mammal species in the fauna of Ukraine, the author emphasised the importance of both this criterion and this feature, and preliminarily associated the appearance of the jackal with the elimination of local wolf populations [Zagorodniuk 2006: 32], as well as their obvious dispersal along motorways, where the deaths of these predators have been noted many times. However, the jackal shows no signs of being an alien species, and it has not colonised agricultural ecosystems or combat zones, as might have been expected. Of course, there have been sightings of jackals in such places: the species has been recorded in agricultural ecosystems in Pokrovsk in Dnipropetrovsk Oblast and Novobakhmutivka in Donetsk Oblast; however, these have always been isolated occurrences, with no repeated records, and clearly concerned transients.

It follows that the process of the jackal's dispersal across Ukraine (and, prior to that, in neighbouring countries) is a natural one, in no way linked to human activity[10]. The only explanation for this is that it is a climate-driven migrant. However, whilst in southern Ukraine this process may be regarded as a recovery of the species' range, in northern Ukraine and in northern countries the species is essentially alien. Nevertheless, it is likely that even in the north its habitats are natural, not anthropogenic, although the routes of dispersal (primarily along artificial ecological corridors—motorways, railways, power lines, gas pipelines, etc.) are unnatural, and so it can be regarded there as a species that is successfully naturalising in the process of dispersal.

[10] This thesis regarding the avoidance of agrocenoses and the naturalness of dispersal was formulated jointly with M. Kolesnikov.

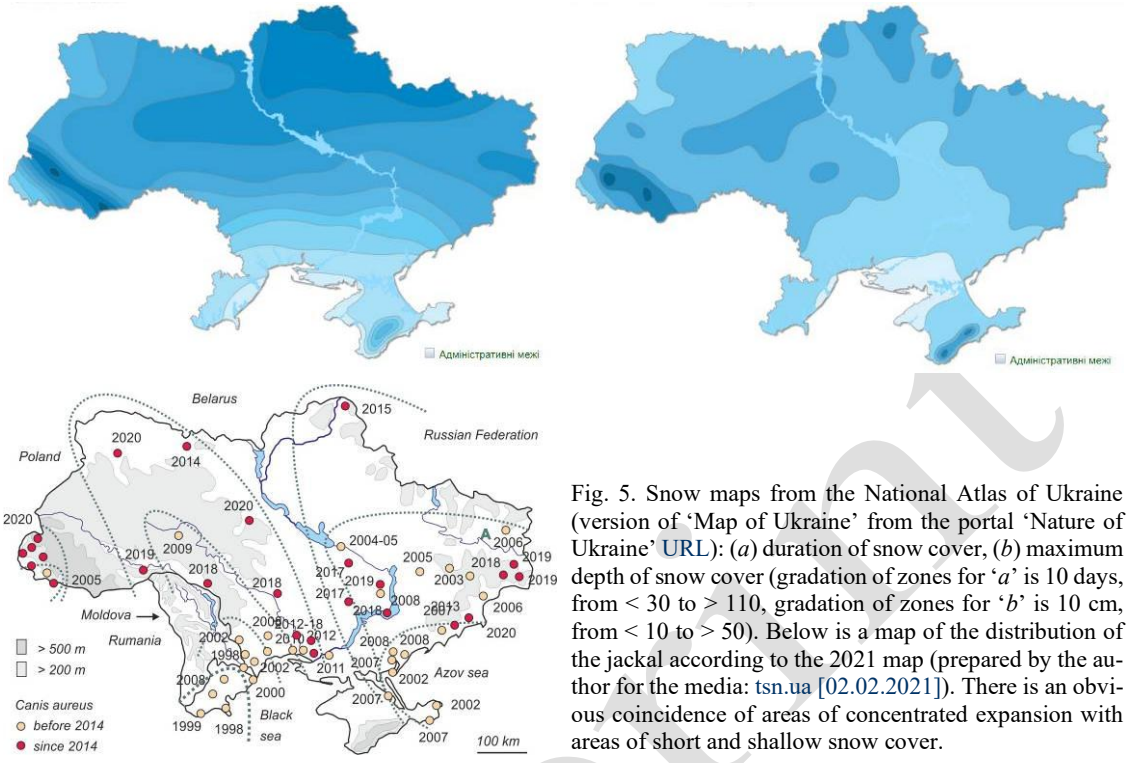

Fig. 5. Snow maps from the National Atlas of Ukraine (version of 'Map of Ukraine' from the portal 'Nature of Ukraine' URL): (*a*) duration of snow cover, (*b*) maximum depth of snow cover (gradation of zones for '*a*' is 10 days, from < 30 to > 110, gradation of zones for '*b*' is 10 cm, from < 10 to > 50). Below is a map of the distribution of the jackal according to the 2021 map (prepared by the author for the media: tsn.ua [02.02.2021]). There is an obvious coincidence of areas of concentrated expansion with areas of short and shallow snow cover.

Рис. 5. Карти снігів із Національного Атласу України (версія «Карти України» з порталу «Природа України» URL): (*a*) тривалість снігового покриву, (*b*) найбільша глибина снігового покриву (градація зон для «*a*» — 10 днів, від < 30 до > 110, градація зон для «*b*» — 10 см, від < 10 до > 50). Внизу — схема поширення шакала за картою 2021 р. (готувалася автором для медіа: tsn.ua [02.02.2021] на основі карти 2014 р. [Zagorodniuk 2014]). Очевидний збіг зон концентрованої експансії з зонами нетривалого і неглибокого снігового покриву.

4.5. Climatic optimum and snow-free zones

It is a widely accepted fact that changes in the environment resulting from climatic processes are a key factor in species distribution [Flores-Manzanero *et al.* 2026]. Climate warming is an unambiguously directed process that alters a range of bioclimatic parameters of the environment [Voloshchuk & Boychenko 2003]. This, in turn, significantly affects the living conditions of animals. Among the latter, the author considers the reduction in the duration of winter and all associated factors to be significant, particularly the shortening of periods of persistent snow cover and sub-zero temperatures.

Numerous studies by climatologists have analysed such changes [e.g., Kongoli *et al.* 2012; Yailymov *et al.* 2023]. It is precisely this that makes new territories accessible (suitable) for jackals: the warming and northward shift (essentially by a couple of hundred kilometres) of the permanent snow cover over the last three decades has significantly increased the availability to this carnivore of various groups of its prey—reptiles, insects, ground-nesting birds and so on, as well as various types of carrion, which under such conditions does not freeze into the ice or become buried in snow. It is likely that a significant proportion of its diet consists of roadkill (birds, dogs, hedgehogs, etc.) [Rozhenko 2006], and the fact that roads are often free of snow and ice may also benefit this species, which is frequently spotted near roads and, due to its feeding habits, often falls victim to road traffic accidents itself.

4.6. Hunting Ban

The hunting ban, which has been in force since 2014, has become a very important factor in the lives of all carnivores in Ukraine. During this period, hunting has been prohibited in most regions, and in the eastern and frontline regions—throughout all these years, in all districts and all forms.

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This has clearly contributed to the growth of populations across all predator species, as widely reported on social media, and has particularly benefited jackals—as 'shadow' predators, the least known to the general public. A surge of reports about the growing jackal population has occurred over the last decade and a half, since 2010, with a clear increase in the number of reports between 2015 and 2025. Unfortunately, standard hunting statistics (2TP hunting) are rather limited due to the cancellation of recording from 2022 onwards, and also because data for the occupied territories were unavailable prior to 2022.

According to official statistics from form '2TP-Hunting', the jackal population in Ukraine is growing at a significant rate; however, these figures relate mainly to the south-east and only partially cover the area under analysis. The jackal 'appears' in Form 2TP only in 2011, i.e. at least 10 years after its probable actual appearance (Table 1).

Overall, over the following 10 years, there was a significant increase in the number of recorded (and also hunted) individuals in Ukraine, from 5–12 individuals per year in 2011–2014 to 687–3389 in the last 4 years, 2022–2025. The number of administrative regions in which it was recorded grew at the same rate: from one region per year in 2011–2014 to 7–8 in 2020–2022 (in recent years, game animal surveys have not been carried out in many areas of the country due to martial law).

It is important to note that in most administrative regions, the number of jackals recorded at the start of the first year of registration was often '0' (see: Table 1); however, during that same year, the number of bagged jackals increased, indicating that the species is actively invading the area and, perhaps, that local hunters are becoming increasingly confident in identifying them.

Currently, the growth in the golden jackal population and the extent of the territories it inhabits in Ukraine has become so rapid that it no longer makes sense to monitor further changes in its distribution. The next step should be to analyse the distribution of the population across regions. Moreover, it is time to control the growth of the jackal population, which hunters are currently doing in many regions on their own initiative, without any record-keeping or reporting, due to restrictions or even bans on hunting (the author has received numerous private reports accompanied by photos and videos from various regions).

Table 1. Distribution of survey data on jackal occurrences and captures by year (harvested in brackets) and a summary of data for the oblasts within the region under analysis*

Таблиця 1. Розподіл облікових даних по знахідках і здобуваннях шакала за роками (здобування у дужках) та деталізація даних для областей регіону, що аналізується*

Year	Number	CHE	DNI	DON	KHA	KHE	LUH	MYK	POL	ZAP
2011	9 (8)	–	–	–	–	0 (1)	–	–	–	–
2012	5 (9)	–	–	2 (4)	–	–	–	–	–	–
2013	12 (16)	–	–	5 (1)	–	–	–	–	–	–
2014	8 (27)	–	0 (7)	–	–	–	–	–	–	–
2015	38 (89)	–	6 (8)	–	–	–	–	–	–	–
2016	105 (185)	–	6 (12)	–	–	0 (5)	–	0 (10)	–	16 (28)
2017	231 (184)	–	8 (6)	–	–	0 (3)	–	6 (16)	–	7 (3)
2018	419 (266)	–	14 (6)	–	–	0 (3)	–	10 (35)	–	5 (4)
2019	285 (357)	–	16 (23)	8 (11)	–	0 (6)	–	15 (86)	–	2 (8)
2020	196 (351)	–	19 (81)	0 (9)	0 (4)	0 (28)	0 (1)	15 (67)	–	14 (11)
2021	344 (467) (R)*	–	16 (66)	10 (11)	2 (5)	0 (44)	–	20 (76)	1 (1)	28 (30)
2022	687 (84) (R)	–	19 (16)	23 (13)	17 (5)	?	?	30 (27)	19 (3)	42 (0)
2023	784 (R)	–	24	?	12	?	?	55	0	?
2024	1882 (R)	14	?	6	42	?	?	108	11	?
2025	3389 (R)	55	140	9	54	?	?	131	18	?

* The '(R)' symbol next to entries indicates data provided by Roman Novikov (UTMR). Acronyms for oblasts (in alphabetical order): CHE—Cherkasy, DNI—Dnipropetrovsk, DON—Donetsk, LUH—Luhansk, MYK—Mykolaiv, KHA—Kharkiv, KHE—Kherson, POL—Poltava, and ZAP—Zaporizhzhia.

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4.7. Combat zones, scavenging

Given the jackal's selective diet and its preference for mammalian carrion, a population increase can be expected in combat zones. This could also have been facilitated by the species' northward expansion from regions regularly affected by military conflict—the Balkans and the Caucasus—which would suggest its active role in consuming the victims of war in Ukraine—both animals killed by explosions and mines, and people, both military and civilian. The numbers of war victims are extremely high, amounting to hundreds of soldiers and hundreds of wild mammals every day. Despite the significant number of such casualties [Zagorodniuk & Vyshnevsky 2022; Zagorodniuk 2024], there are no clear signs of an increase in the jackal population in combat zones or of their involvement in scavenging on corpses.

The author has analysed various types of data from open sources quite thoroughly and interviewed many military colleagues—there are no such facts, although this was expected in the initial hypothesis due to the jackals' obvious interest in carrion [Rozhenko 2006]. On the internet, only one case outside the combat zone has been described, in Odesa Oblast; however, no such cases have been noted within the combat zone. Despite this, such cases—and there are numerous ones—have been observed for pigs, cats, and, in particular, dogs. Moreover, pigs (especially feral domestic ones) consume corpses whole (URL etc.), whereas carnivores primarily damage exposed parts of the body. In other words, scavenging is not a characteristic that could have facilitated the jackal's settlement in combat zones. This niche in the combat zones has been filled by the numerous stray dogs found there, and in some places by cats and pigs. In such areas, 'where it is impossible to evacuate the dead, there are a great many gnawed [by dogs] corpses, numbering in the dozens at each location. And not a single jackal has been spotted' (O. German, pers. comm.; near Kostyantynivka). This is confirmed by other reports from colleagues and numerous media sources, particularly interviews with search teams removing the bodies of fallen soldiers.

This phenomenon has previously been observed in foxes in Crimea, as described in detail in the thesis by the renowned Soviet-era game expert M. Pavlov [Saveliev & Boiarintseva 2014][11]. He cites information from staff at the Crimean Nature Reserve who were active as partisans in those areas during the Second World War. 'In some seasons, carrion made up a significant part of the fox's diet. […] The former commander of the [Yalta] partisan detachment, I. V. Krapivny, told postgraduate student Pavlov […]: "The number of foxes on human corpses sometimes reached more than ten"' (p. 66 in Pavlov's thesis). It is hard to imagine foxes feeding on corpses and arriving in packs of 10 individuals per corpse. Perhaps they were jackals?

So, the key question is: why do jackals not thrive in combat zones? In the author's view, this is due to constant unrest, which may be a characteristic of this species' behaviour. This niche is easily filled by anthropophiles—dogs, cats, pigs, and crows. And, unafraid of people or gunfire, they perform this function more effectively than jackals.

5. Adverse factors

5.1. General situation

Adverse factors include both limits on the distribution or reproduction of the species, as well as threats to its survival. Statistics show that, taken individually, various factors contributing to mortality (rabies, roadkill, and hunting) do not have a significant impact on the growth of the jackal population; however, their combined effect may prove to be significant. It is clear that the greatest threats are the disappearance of favourable factors, particularly climatic ones; therefore, climate change will be (and has clearly been on more than one occasion) the key cause of species extinction within Ukraine. Given current patterns of nature use and the intensity of traffic on roads and railways (which 'create' a broad food source in the form of roadkills), there can be no shortage of food; therefore, the trophic factor cannot be critical.

[11] Pavlov, M. P. 1948. The ecology of the Crimean mountain fox and methods for regulating its population in the Crimean State Nature Reserve: doctoral thesis. Moscow Fur Institute, Balashikha, 1–185.

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5.2. Threats

There are four factors that may pose a threat to this species: zoonoses (primarily rabies), hunting, disturbance (particularly in breeding habitats), and biocenotic threats linked to its position within the carnivore guild.

Zoonoses are a significant factor affecting the survival of many mammal species; in the case of carnivores, rabies is a key zoonosis, particularly in eastern Ukraine [Zagorodniuk & Korobchenko 2007]. The first official case of rabies in a jackal in Ukraine was recorded in 2015 [Kornienko *et al.* 2019], but such cases are now common. In particular, rabies has been recorded in Crimea; there have been reports of rabies in jackals in Odesa Oblast; and there are numerous reports in the areas from which the species expanded into eastern Ukraine (notably in the Rostov and Krasnodar regions). For example, according to data from the State Forestry Agency of Ukraine (URL, 16/05/2024), in Odesa Oblast, rabies was confirmed in 17 out of 69 jackals obtained for analysis (24.6%). Similar reports in the media come from various regions of the Black Sea region [Nakonechnyi *et al.* 2019], from Crimea (2019, the Mysovska hunting grounds), and Mariupol (2022, the city market!). Overall, the involvement of jackals in the rabies zoonosis is entirely to be expected, and these animals' high level of socialisation and ability to migrate long distances may contribute to its widespread transmission.

Regulating the jackal population (essentially eliminating them) is an urgent necessity for all hunting grounds. There are numerous videos and photos online of successful jackal hunts, some of which are cited in the registers (see above). The author also possesses a considerable number of such photos and videos from hunters; however, unfortunately, they cannot be presented as illustrations due to their content and the terms of use. In any case, we are talking about dozens of animals killed in various regions. However, as hunting statistics show (see Table 1), the removal of even the majority of jackals by the end of the year, compared to the number recorded at the start of the year, has no effect whatsoever on population growth, which is steadily increasing year by year across the entire range. A similar pattern has been noted in the Ciscaucasia: even significant hunting pressure, with up to one-third of the population being taken annually, does not restrict the growth of the jackal population [Kudaktin *et al.* 2019].

Disturbance is too general a factor to analyse; however, it has been noted above that, contrary to expectations, there are very few individuals of this species in areas close to the combat zone. In the author's view, this is also linked to the wariness of these animals and their tendency to avoid any sources of disturbance, including belloid ones. Despite the apparently favourable 'feeding' conditions in combat zones, as shown by mapping of findings from all available sources, no obvious concentration of jackals has been observed there, although the potential for colonisation is extremely high. Therefore, the reason can be considered to be their avoidance of the entire complex of belloid factors, particularly the direct impacts of military manoeuvres and combat operations and warfare-induced environmental degradation in a whole (for factors, see: [Zagorodniuk 2024]).

The arrival of jackals has given rise to a threat of a biocoenotic nature: their predation on the local wild fauna, which also forms part of their diet [Rozhenko 2006]. An example is the locality of Novovasylivka (Berdiansk Raion; E7), where jackals actively prey on domestic animals. It is clear that there is also the issue of the species integrating into faunal communities that are new to it, particularly within the structure of the canid guild [Zagorodniuk & Lazariev 2024]. However, as the analysis shows, the jackal has fitted well into this guild, occupying a vacant niche between the fox and the wolf and, in terms of its diet (carrion), is unrivalled as a scavenger.

5.3. On hybrids

The jackal can produce hybrids with stray dogs, similar to the hybridisation of wolves with dogs, which has been documented in various regions [Gursky 1975; Tirronen & Kuznetsova 2025]. Such situations arise when the structure of wild predator populations is disrupted, particularly due to a lack of mating partners [Zhyla 2006; Zagorodniuk 2011]. 'Problematic' jackal sightings are sometimes classified as hybrids. For instance, in Sumy Oblast, 'wolf-dog hybrids' were recorded over several years up to 2017, which were most likely jackals [Merzlikin 2025: 73].

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Research into molecular markers suggests that hybrids between jackals and dogs are not uncommon [Stefanović *et al.* 2024; Flores-Manzanero *et al.* 2026]. It is clear that hybridisation is facilitated by the dispersal of jackals, which can lead to a shortage of mates. One of the problematic specimens, with an unusually thick and light coat but with the stature and proportions typical for jackals (Fig. 1, *c*), was found dead on a motorway in the Donetsk Ridge in 2012. The literature also mentions genetically confirmed hybrids from southern Ukraine [Stefanović *et al.* 2024]. It is possible that this phenomenon of hybridisation as the population disperses is similar to the behaviour of a compilospecies. However, further population growth should lead to the extinction of hybridisation.

Afterword

During the discussion of this study's results, one of my military colleagues (O. German) raised a question of importance for future discussions: 'What next? What should or should not be done about this?' The answers can be summarised as follows:

1) It is necessary to accept the fact of the jackal invasion, which should be viewed partly as a return of the species (in the south) and as an expansion into new territories for the species (in the north) in the context of global warming; an important factor in population growth in Ukraine has been the hunting ban of 2014–2025 and the general weakening of hunting pressure on carnivore populations;

2) in the coming years, further growth in the jackal population can be expected, which will lead to a reduction in hunting resources and the population density of terrestrial vertebrates, particularly medium-sized mammals and ground-nesting waterbirds, primarily due to the vulnerability of juveniles;

3) the growth in jackal numbers will clearly exceed the carrying capacity of natural habitats and must therefore be managed by humans, including near settlements and in specific habitat types where predator control is important, particularly within protected areas.

Thus, *Canis aureus* has successfully reclaimed its status as a native species in Ukraine and neighbouring countries, with the help of both nature and humans. However, as an apex predator, it acts not only as a regulator of prey populations but also as a predator that successfully increases its abundance by feeding not only on natural resources but also on domestic animals and victims of man-made traps (including roadkill). Thanks to its ability to switch between different food sources, this species can increase its numbers under a variety of conditions. In fact, the only biotic mechanism regulating its populations is zoonoses and human activity.

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