


First records of introduced slugs of the genus *Limacus* (Gastropoda: Limacidae) in the Lviv region and their present distribution in Ukraine

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The first findings of *Limacus flavus* in the Lviv region, Western Ukraine, are described. One specimen was shown with an atypical body colouration, without yellow mucus covering it, with a monochromatic back and an almost complete absence of a reticulate pattern on the mantle, assigned to the genus *Limacus* only after dissection. An analysis of our own and literature data, as well as observations from two citizen science databases, showed that both *Limacus* species rapidly expand their ranges in Ukraine due to anthropochory. *Limacus maculatus* is more common outdoors, while *L. flavus* is more common in basements and other enclosed rooms. Most *Limacus* records have been made in Crimea, which is part of the natural range of *L. maculatus*, and in the Kyiv region, where both species were introduced. In Western Ukraine, only *L. flavus* has been reliably registered so far, a few anatomically verified findings were made at the beginning of the 21st century in Lviv, Rivne and Khmelnytskyi regions.

Key words: *Limacus flavus*, *Limacus maculatus*, land molluscs, introduction, anthropochory, alien species, Ukraine

Introduction

In recent decades, the amount of data on the distribution of slugs of the genus *Limacus* in Ukraine has been rapidly increasing, which is reflected both in malacological publications (BALASHOV & MARKOVA 2021, BALASHOV & SVERLOVA 2007, CHERNYSHOVA 2016, CHERNYSHOVA et al. 2010, GARBAR & CHERNYSHOVA 2011) and more frequent observations from different parts of the country, posted in citizen science databases (iNATURALIST 2022, UKRBIN 2022). The latter began to appear especially frequently in 2020–2022. Although the photographs in the databases make it possible to reliably identify only the genus, but not the species of slugs (see Material and methods), our data accumulated since 1998 and the publications listed above indicate a significant expansion of the ranges of *Limacus flavus* (Linnaeus, 1758) and *L. maculatus* (Kaleniczenko, 1851) in Ukraine.

So far, only one species, *L. flavus*, has been recorded in Western Ukraine (GURAL-SVERLOVA & GURAL 2021). The first reliable, anatomically verified findings of this species were made in 2008 (CHERNYSHOVA et al. 2010) or 2009 (GARBAR & CHERNYSHOVA 2011) in two settlements of Rivne and Khmelnytskyi regions. Although theoretically quite probable, the earlier mention of *L. flavus* for the Transcarpathian region by POLEVINA (1959) has not yet been confirmed by further malacological studies of this area. In particular, BAIDASHNIKOV (1985, 1988) does not

mention this species either for the Transcarpathian region or as a synanthropic element of the land mollusc fauna of the Ukrainian Carpathians as a whole. In the list of land molluscs of the Transcarpathian region, given by POLEVINA (1959), there are some dubious species. It is also not known whether anatomical features or only appearance were used by her when identifying slugs. The presence of incorrect identifications was also confirmed by the revision of part of her collection (unfortunately, only dry shells of snails) stored in the Zoological Museum of Uzhgorod National University (GURAL-SVERLOVA 2016).

In 2022, slugs of the genus *Limacus* were found in the administrative centres of two other regions of Western Ukraine. The database iNATURALIST (2022) contains a photograph of one specimen of *Limacus* sp. taken at the Ternopil railway station. In September 2022, we made anatomically verified findings of *L. flavus* at three sites located not very far from the central part of Lviv, which will be described in this publication. Of particular interest is the discovery of an atypically coloured specimen of this species, because its assignment to the genus *Limacus* was established only after dissection.

Due to the emergence of a large amount of new data (see above), the previous review of information on the distribution of slugs of the genus *Limacus* in Ukraine (BALASHOV & SVERLOVA 2007) is very outdated. And subsequent publications (BALASHOV & MARKOVA 2021, CHERNYSHOVA 2016, CHERNYSHOVA et al. 2010) were devoted

primarily to describing particular findings of *L. flavus* and *L. maculatus* made by different authors. Therefore, the second goal of our publication was to analyse the present distribution of *Limacus* species in Ukraine and assess trends in the expansion of species ranges.

Material and methods

In Lviv, specimens of *L. flavus* were collected in September 2022 at three sites.

Site 1 – Heroiv UPA Street, No. 36, non-residential premises in the courtyard used as a sculpture workshop, indoors, 49°50'00.0"N 24°00'01.9"E, two adults (Fig. 1A, B) and two juveniles, coll. T. Rodych.

Site 2 – near the intersection of Andriy Melnyk Street and Serhiy Yefremov Street, a green area near the Lviv regional medical and sports dispensary (the former Józefa Franz Villa), near the fence, 49°49'50.3"N 24°00'15.1"E, one adult slug of atypical colouration (Fig. 1E–H), coll. N. Gural-Sverlova.

Site 3 – Kyivska Street, No. 9, on the fence near an apartment building, 49°49'58.4"N 24°00'36.2"E, one adult (Fig. 1C, D), coll. N. Gural-Sverlova.

The distances between sites 1 and 2, 2 and 3 are about 300 m. Sites 1 and 3 are no more than half a kilometre apart.

In addition to the usual search for slugs, timed to coincide with rainy periods and morning hours after rains, bait in the form of pumpkin or vegetable marrow pieces was used at sites 1 and 2. In the first case, the bait was laid out inside the workshop and around it, in the courtyard between apartment buildings. In the second case, pieces of vegetable marrow were laid out along the fence that bounded the green area around the dispensary.

The collected slugs were preserved by the so-called “hard” fixation (LIKHAREV & WIKTOR 1980) by immersing them immediately in 70% ethanol.

To analyse the present distribution of slugs of the genus *Limacus* in Ukraine, the following data were used:

1) anatomically verified findings made personally by the first author of the article or transferred for identification to the laboratory of malacology of the State Museum of Natural History in Lviv in the period from 1998 to 2022 by other persons listed in the Acknowledgments; these data were partially summarized in a previous publication (BALASHOV & SVERLOVA 2007);

2) similar published data of other researchers (BALASHOV 2013, BALASHOV & BAIDASHNIKOV 2012, 2013, BALASHOV & MARKOVA 2021, CHERNYSHOVA 2016, CHERNYSHOVA et al. 2010, GARBAR & CHERNYSHOVA 2011, LIKHAREV & WIKTOR 1980);

3) observations from two databases (iNATURALIST 2022, UKRBIN 2022), confirmed by photographs of live slugs. Earlier studies in Ukraine (BALASHOV & MARKOVA 2021, BALASHOV & SVERLOVA 2007) have shown that reliable differentiation between *L. flavus* and *L. maculatus* is not possible based on the slug appearance alone, without examining their genitalia. Therefore, such observations were considered as “*Limacus* sp.”.

For the anatomical differentiation of *L. flavus* and

L. maculatus, the features described in the monograph by LIKHAREV & WIKTOR (1980) were used: 1) the duct of the bursa copulatrix (spermatheca) opens into the expanded anterior part of the oviduct in *L. flavus* or into the atrium in *L. maculatus*; 2) the oviduct in *L. maculatus* is cylindrical, not expanded in front, as in *L. flavus*.

Results

At site 1, adult (Fig. 1A, B) and juvenile (body length after fixation from 8 to 13 mm) slugs were collected only inside the workshop. In the courtyard surrounding it, only single specimens of other introduced species of land molluscs were found: *Oxychilus draparnaudi* (Beck, 1837) and *Cornu aspersum* (O. F. Müller, 1774). *Cornu aspersum* was first recorded in and near Lviv in 2021 (GURAL-SVERLOVA & GURAL 2021).

At other sites, single adult slugs (Fig. 1C–F) were collected outdoors, however, at a small distance from the dispensary (site 2) and an apartment building (site 3). It is possible that during long rainy periods, these individuals crawled out from the basements of buildings. Despite repeated inspections of the periphery of the green area around the dispensary and the use of baits (see Material and methods), no other specimens of *L. flavus* were found. At the same time, the baits attracted smaller species of slugs: *Dero-ceras reticulatum* (O. F. Müller, 1774), *D. caucasicum* (Simroth, 1901), *Krynickyllus melanocephalus* Kaleniczenko, 1851, *Arion distinctus* Mabille, 1868, which are now quite common for the urbanised habitats of Lviv.

Slugs from sites 1 (Fig. 1 A, B) and 3 (Fig. 1 C, D) had a colouration typical of the genus *Limacus*: yellow or orange mucus densely covering the body, except for the sole, and dark (grey to dark grey) reticulate pattern on the back and mantle. A live slug collected at site 2 (Fig. 1E) had neither such mucus colour nor such pattern. The back and mantle looked uniform, light beige, and the tentacles were greyish, as in typical *L. flavus* (Fig. 1A, C). After fixation, a greyish tinge appeared in places on the mantle, especially in its central part (Fig. 1F), and on the body sides closer to the edge of the sole and the tail. A faint reticulate pattern was observed along the edges of the mantle (Fig. 1G, H). A few dark grey dots were also visible on the mantle. The back remained monochromatic and retained the same colour as that of a living slug.

In all dissected adult slugs, regardless of body colouration (see above), the duct of the bursa copulatrix did not open into the atrium but into the expanded anterior part of the oviduct (Fig. 2). This not only makes it possible to simply differentiate *L. flavus* from *L. maculatus* (LIKHAREV & WIKTOR 1980) but is also an exceptional case within the whole family Limacidae (WIKTOR 2001).

In Ukraine, slugs of the genus *Limacus* are distributed today from the Crimean Peninsula and coastal areas in the south to most of the northernmost administrative regions (Rivne, Zhytomyr, Kyiv, Chernihiv, Sumy), as well as from the Donetsk Upland in the east of the country to the Lviv region in its western part (Fig. 3). The largest number of known records was made in Crimea, which is considered part of the natural range of *L. maculatus* (see

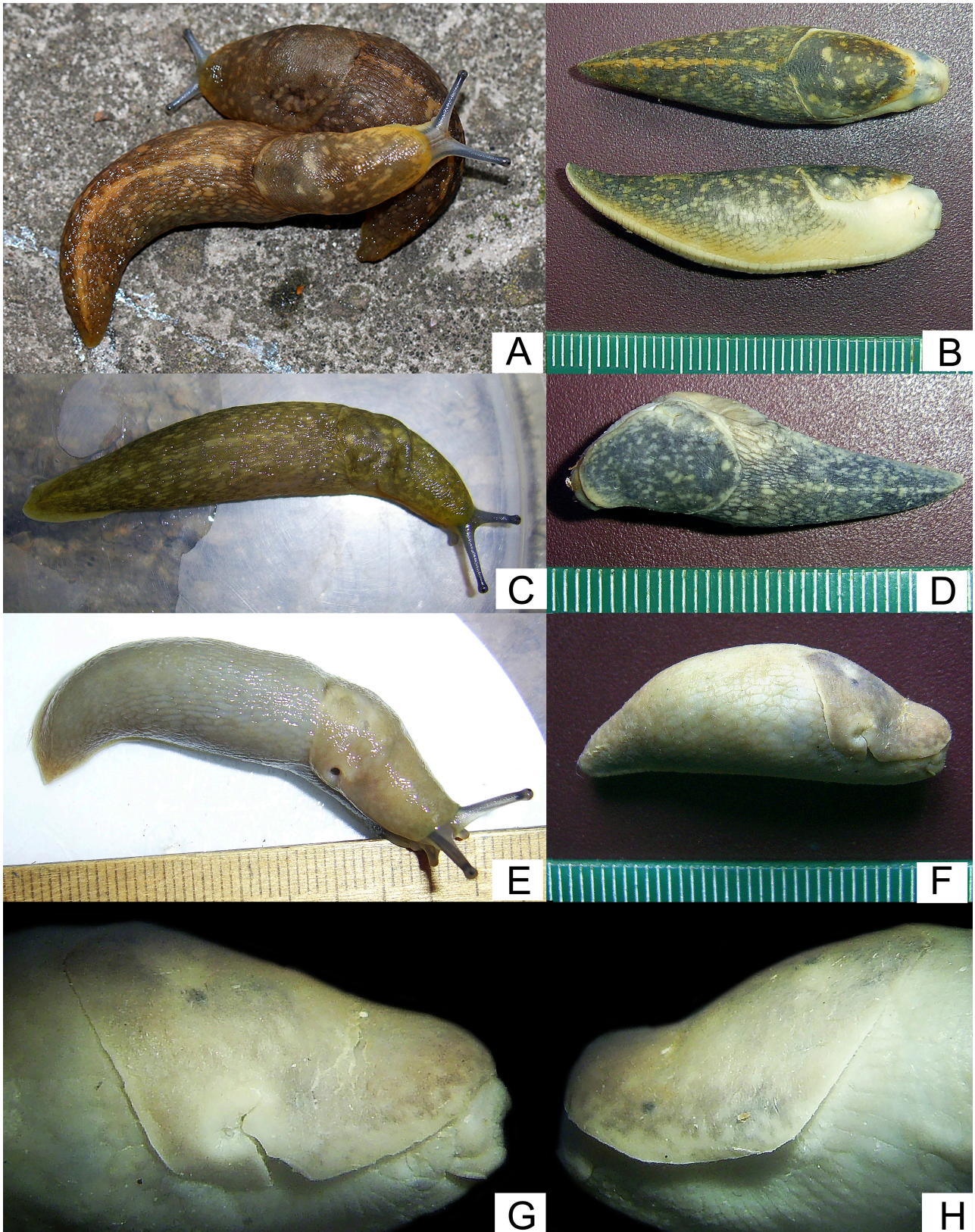


Fig. 1. Appearance of *L. flavus* from Lviv: A, B – site No. 1; C, D – site No. 3; E, F – atypically coloured slug, site No. 2; G, H – the mantle of the same specimen on both sides. Photos by T. Rodych (A) and N. Gural-Sverlova (the rest).

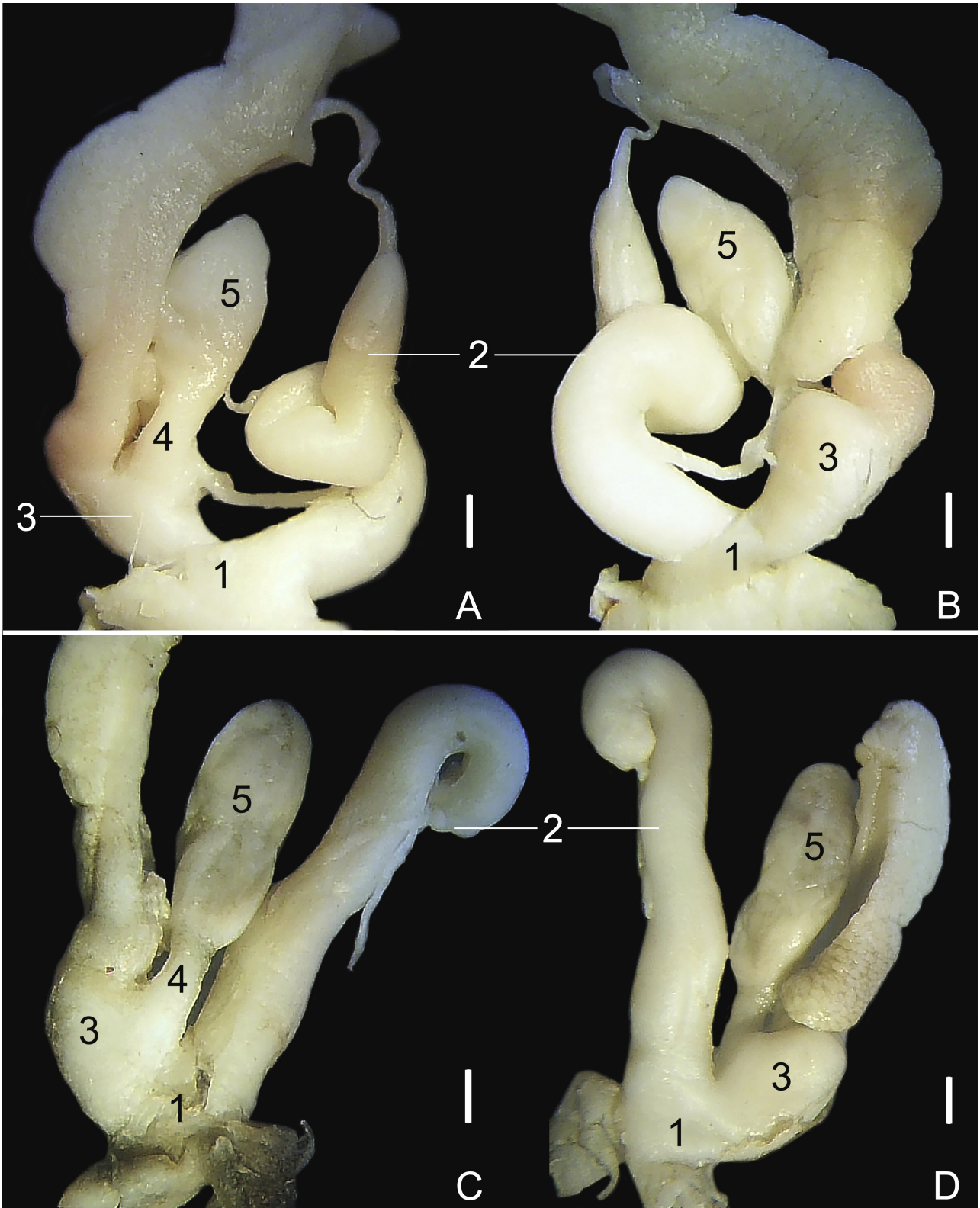


Fig. 2. Genitalia of *L. flavus* from Lviv: A, B – one specimen from site No. 1; C, D – atypically coloured slug from site No. 2. Numbers indicate: 1 – atrium; 2 – penis; 3 – an expanded section of the oviduct, into which the duct of the bursa copulatrix opens; 4 – duct of the bursa copulatrix, 5 – bursa copulatrix (spermatheca). Scale bar 1 mm. Photos by N. Gural-Sverlova.

Discussion), and in the Kyiv region in Central Ukraine (Tab. 1). To date, reliable, anatomically verified records of *L. maculatus* from 9 administrative regions of Ukraine and *L. flavus* from 11 regions are known. For 6 regions (Chernihiv, Dnipropetrovsk, Poltava, Sumy, Ternopil, and Kharkiv), slugs of the genus *Limacus* are known so far only from observations in citizen science databases (Tab. 1).

Discussion

Limacus flavus and *L. maculatus* are similar in appearance and have similar ecological preferences and predispositions to synanthropisation (WIKTOR 1989).

At present, the ranges of both species are significantly expanded due to anthropochory, see a review of the related references in BALASHOV & MARKOVA (2021). *Limacus flavus* is considered of Mediterranean origin, although the exact boundaries of its natural range are unknown. According to WIKTOR (1989), this could be southeastern Europe and possibly Asia Minor. Consequently, this species is alien to the entire territory of Ukraine.

Limacus maculatus probably originally occurred in the Black Sea area, i.e. the Caucasus, Crimea and the Black Sea Coasts of Romania and Bulgaria (WIKTOR 2001) and possibly Anatolia (WIKTOR & NORRIS 1982). In addition to Crimea, part of this species' natural range in Ukraine may also be the Donetsk Upland in the east of the country (BALASHOV 2016, BALASHOV & MARK-

OVA 2021). So, at the beginning of the 21st century, *L. maculatus* was found in flooded forests in the south of the Luhansk region, along with some land mollusc species of Caucasian origin: *Elia novorossica* (Retowski, 1888), *Boettgerilla pallens* Simroth, 1912, *Deroceras caucasicum* (Simroth, 1901) (BALASHOV 2013). Since *B. pallens* and *D. caucasicum* are currently found in different parts of Ukraine as synanthropic, the most significant in this case is the joint discovery of *L. maculatus* and *E. novorossica* (Clausiliidae). Before 2008 (GURAL-SVERLOVA & MARTYNOV 2009), all known records of *E. novorossica* were made in the western Caucasus between Novorossiysk and Anapa (LIKHAREV 1962, SYSOEV & SCHILEYKO 2005).

The monograph on slugs of the former USSR (LIKHAREV & WIKTOR 1980) mentions that *L. maculatus* occurs in natural biotopes only in Crimea and the Caucasus. The findings in the cellars and greenhouses of some settlements are also reported, only one of which (Sevastopol) is located in Ukraine. PUSANOV (1925) mentioned occasional findings of *Limax variegatus* Draparnaud, 1801 in the environs of Simferopol and Yalta and in Simeiz, Crimea. Although *L. variegatus* is now considered a synonym for *L. flavus* (WIKTOR 1989, 2001), it is more likely that, in this case, it was *L. maculatus*. At the end of the 20th century, there was a proposal to include *L. maculatus* in the regional Red Book of Crimea (POPOV 1999).

The same monograph (LIKHAREV & WIKTOR 1980) reports the findings of *L. flavus* in the cellars and greenhouses of

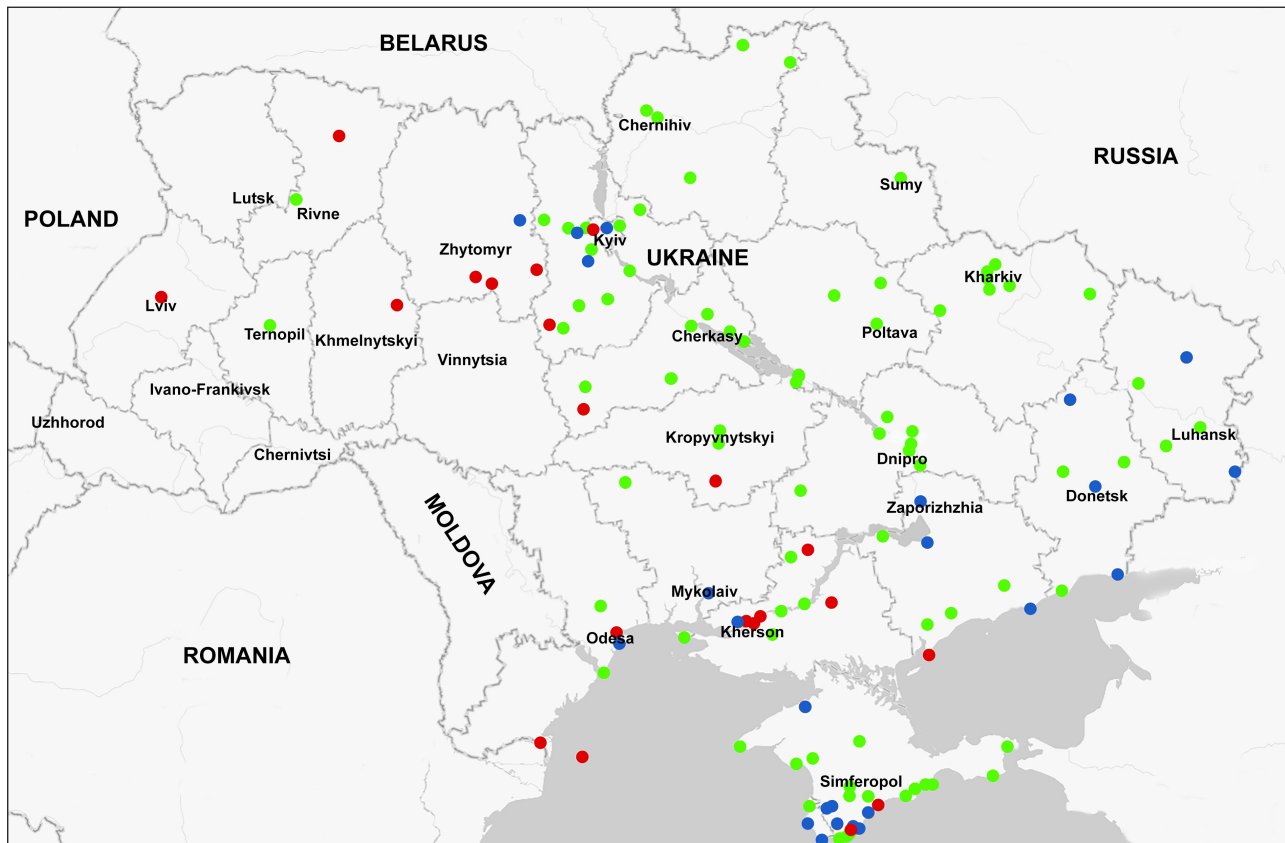


Fig. 3. Distribution of slugs of the genus *Limacus* in Ukraine: red circles are anatomically verified records of *L. flavus*, blue ones are the same for *L. maculatus*, green ones are observations of *Limacus* sp. based on photographs from databases (iNATURALIST 2022, UKRBIN 2022).

some settlements of the former USSR, among them Odesa, as well as in one orchard of Yalta, the Southern coast of Crimea. More recent studies have confirmed the presence of *L. flavus* in the cellars of Odesa (BALASHOV & SVERLOVA 2007) and in one garden biotope on the Southern coast of Crimea, in Malorichenske (CHERNYSHOVA et al. 2010). Since the late 1990s, the number of reports about the findings of slugs of the genus *Limacus* in different administrative regions of Ukraine has been rapidly increasing. This may be partly due to global climate change, which, combined with the specific microclimate of settlements, allows more southern and heat-loving species of molluscs to adapt successfully to living in an urbanised environment, even in the most northern regions of the country. A good example of this is the appearance of some land mollusc species of Crimean origin – *Brephulopsis cylindrica* (Menke, 1828), *Monacha fruticola* (Krynicky, 1833) – in Western Ukraine (GURAL-SVERLOVA & GURAL 2020, SVERLOVA 1998), in Kyiv (BALASHOV 2008, iNATURALIST 2022) and even in Belarus (RABCHUK & ZEMOGLYADCHUK 2011). The first anatomically verified records of *L. maculatus* in Ukraine outside Crimea were made in 1998 in Mykolaiv (KRAMARENKO & SVERLOVA 2001) and 1999 in Odesa. In both cases, the slugs were collected outdoors, in park or garden biotopes. Soon *L. maculatus* was also registered in other localities in the south and east of Ukraine: in Kherson, Zaporizhzhia and Donetsk regions (BALASHOV & SVERLOVA 2007). This allowed us to conclude that *L. maculatus* is now quite widespread in the steppe zone of Ukraine, at least in settlements and their immediate environs.

In 2006, *L. maculatus* was first found in Central Ukraine, in a ravine overgrown with trees and shrubs near Vasylkiv town, Kyiv region (BALASHOV & SVERLOVA 2007). In subsequent years, this species was also recorded in other localities of the Kyiv region, including Kyiv (BALASHOV 2008), and in the neighbouring Zhytomyr region (CHERNYSHOVA 2016, CHERNYSHOVA et al. 2010). Since the land molluscs of Kyiv were periodically studied, starting from the middle of the 19th century (TAPPERT et al. 2001), it is logical to assume that the introduction of *L. maculatus* into the urbanised biotopes of this city occurred no earlier than the end of the 20th century (BALASHOV 2008).

Research by Zhytomyr malacologists, mainly associated with cellars (CHERNYSHOVA et al. 2010), significantly supplemented the anatomically verified data on the distribution of *L. flavus* in Ukraine. Prior to this, *L. flavus* was reliably known only from Odesa, Yalta (see above) and from the small Zmiinyi Island (also known as Snake Island or Serpent Island) in the Black Sea, where it was collected in 2005 (BALASHOV & SVERLOVA 2007). They found *L. flavus* also in Zhytomyr, Kyiv, Cherkasy, Kirovohrad, Zaporizhzhia, Kherson, Rivne, and Khmelnytskyi regions, as well as in two additional localities of Crimea and Odesa region (CHERNYSHOVA 2016, CHERNYSHOVA et al. 2010, GARBAR & CHERNYSHOVA 2011).

In 2020–2021, evidence was obtained that even under the climatic conditions of Kyiv, *L. flavus* is able not only to spend the warm season but also, possibly, successfully overwinter outdoors, hiding in various cavities in the

trunks of old trees, mainly poplars (BALASHOV & MARKOVA 2021). Perhaps this may lead even in the north of Ukraine to the formation of stable populations of this species, not necessarily associated with the basements of buildings and with other closed rooms. According to WIKTOR (2004), *L. flavus* is a forest species in countries with warmer climates, often hiding in tree cavities. This also applies to trees growing in cities along the streets.

It is interesting that so far, not a single fact of cohabitation of *L. flavus* and *L. maculatus* has been registered in Ukraine, although in some cases, both species were recorded in the same settlement, for example, in Odesa or Kyiv, or similar types of habitats, for example, in cellars or gardens. In general, *L. flavus* was more often found indoors and *L. maculatus* outdoors, which indicates better adaptability of the latter species to the climatic conditions of Ukraine.

According to some authors (LIKHAREV & WIKTOR 1980, ROWSON et al. 2014), external features make it possible to distinguish between *L. flavus* and *L. maculatus* even without examining their genitalia. Such differences may be very useful when analysing information from databases containing photographs of live slugs (iNATURALIST 2022, UKRBIN 2022). However, first, such photographs are usually taken by persons who do not specialise in malacology and therefore do not always choose the right angles. The image quality also does not always make it possible to see some details of the slug colouration clearly. Second, observations in Ukraine have shown that the indicated colouration features do not always allow reliable identification of *L. maculatus* (GURAL-SVERLOVA & GURAL 2012) or *L. flavus* (BALASHOV & MARKOVA 2021). And the colouration of *L. flavus* only in Lviv varied so much that one specimen (Fig. 1E) was assigned to the genus *Limacus* only after dissection (see above).

According to LIKHAREV & WIKTOR (1980), the grey reticulate pattern on the upper part of the body is somewhat more distinct and reaches the very edge of the sole in *L. maculatus* or gradually disappears at some distance from the sole in *L. flavus*. The latter, in particular, could be seen in specimens of *L. flavus* collected in Lviv at sites 1 (Fig. 1B) and 3. Our observations have shown that the reticulate pattern in *L. maculatus* also does not always reach the very edge of the sole but may gradually disappear at some distance from it. In addition, this can happen so smoothly that it is sometimes difficult to determine where grey pigmentation is still present, even if it is weak, and where it is no longer present (GURAL-SVERLOVA & GURAL 2012). BALASHOV (2016) came to a similar conclusion about the impossibility of using the features proposed by LIKHAREV & WIKTOR (1980) for reliable differentiation of *L. maculatus* and *L. flavus*. In general, the intensity of pigmentation in many species of slugs varies greatly, and it can also change with age (LIKHAREV & WIKTOR 1980).

As another distinguishing feature, the presence of a light longitudinal band in the middle of the back in *L. flavus* was mentioned (ROWSON et al. 2014). Such a band was indeed observed in adults of this species from site 1 in Lviv (Fig. 1A, B). In the only specimen from site 3 (Fig. 1C, D), it was much less pronounced and did not reach the

edge of the mantle, which is especially noticeable in the fixed slug (Fig. 1D). In one population of *L. flavus* from Kyiv recently studied in detail, such a light band was present only in some slugs, mostly in juveniles, and did not extend the whole length of the back (BALASHOV & MARKOVA 2021).

Among the images of slugs of the genus *Limacus* from the databases (iNATURALIST 2022, UKRBIN 2022) analysed by us, in most cases, there were even no traces of the light band on the back described above. A distinct light band was more frequently present in images from the Kharkiv region and Crimea. Since the photographs from different regions of Ukraine, placed in the analysed databases, were taken outdoors, it could be assumed that they more often depict specimens of *L. maculatus*. If not for the observations of BALASHOV & MARKOVA (2021) cited above, this could be indirectly confirmed by the ratio of different colouration variants.

In Western Ukraine, very few findings of slugs of the genus *Limacus* are known so far, which is especially noticeable in comparison not only with the southern but also with the central part of Ukraine (Tab. 1, Fig. 3). In addition, *L. maculatus* has not yet been reported from there, although its anatomically verified records have been documented from nine regions of Ukraine, including Crimea (Tab. 1). However, this species may likely be found in Western Ukraine soon. For comparison: two slug species of Caucasian origin, already mentioned above *K. melanocephalus* and *D. caucasicum*, until recently known in Ukraine only from Crimea (ЛИХНЯРЕВ & ВИКТОР 1980), were recorded at first in Kyiv, in 1998 and 2007, respectively (GURAL-SVERLOVA et al. 2009; KOROL & KORNIUSHIN 2002), and after a short time also in Lviv, in 2000 and 2014 (GURAL-SVERLOVA & GURAL 2021).

Conclusions

The analysed data showed that both *Limacus* species rapidly expand their ranges in Ukraine due to anthropochory. *Limacus maculatus*, autochthonous for Crimea and possibly for the Donetsk Upland in Eastern Ukraine, is more often recorded outdoors. *Limacus flavus*, in contrast, is more commonly found in basements and other enclosed rooms. However, recent observations in Kyiv indicate that this species can probably successfully overwinter outdoors even in settlements in the north of the country.

To date, most of the records of *Limacus* in Ukraine are known from Crimea and the Kyiv region. In the west of Ukraine, only *L. flavus* has been reliably recorded so far, with a few anatomically verified findings in Lviv, Rivne, and Khmelnytskyi regions.

The characteristic colouration of slugs of the genus *Limacus* makes it easy to identify them even in photographs from citizen science databases, which significantly expands the available data on their present distribution in Ukraine. However, according to the observations of Ukrainian malacologists, including our personal data, body colouration does not make it possible to reliably differentiate specimens of *L. maculatus*, and *L. flavus* collected in Ukraine.

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Table 1. Localities in Ukraine in which slugs of the genus *Limacus* were reliably registered: 1 – anatomically examined by the first author of the article; 2 – anatomically verified records, literature data; 3 – according to observations from databases.

Regions	<i>L. flavus</i>	<i>L. maculatus</i>	<i>Limacus</i> sp.
Western Ukraine			
Khmelnyskyi	Ladyhy ²	–	
Lviv	Lviv ¹	–	–
Rivne	Sarny ²	–	Klevan ³
Ternopil	–	–	Ternopil ³
Central Ukraine			
Cherkasy	Uman ²	–	Dzenzelivka ³ , Lozivok ³ , Prydniprovsk ³ , Shpola district ³ , Veremiivka ³ , Zolotonosha ³ ,
Chernihiv	–	–	Chernihiv ³ , Novhorod-Siverskyi ³ , Rudka ³ , Semenivka ³ , Volodkova divytsia ³
Dnipropetrovsk	–	–	Dnipro ³ , Kamianske ³ , Kryvyi Rih ³ , Loboikivka ³ , Nikolske-na-Dnipri ³ , Novooleksandrivka ³
Kirovohrad	Bobrynets ²	–	Kropyvnytskyi ³ , Stepove ³ , Svitlovods district ³ ,
Kyiv	Kyiv ² , Rubchenky ²	Kyiv ¹ , Mriia ² , Vasylykiv ¹	Brovary ³ , Hlevakha ³ , Irpin ³ , Makivka ³ , Mykolaivka ³ , Shevchenkove ³ , Shkarivka ³ , Staiky ³ , Volodarka ³ , Zabuiannia ³
Poltava	–	–	Poltava ³ , Kremenchuk ³ , Opishnia ³ , Yaresky ³
Sumy	–	–	Sumy district ³
Zhytomyr	Chervone ² , Kornyn ² , Reia ²	Mala Racha ²	
Eastern Ukraine			
Donetsk	–	Donetsk ¹ , Cherkaske ¹ , Novoazovsk ¹	Selydove ³ , Yalta ³ , Yenakiieve ³
Kharkiv	–	–	Kharkiv ³ , Babai ³ , Dvorichna ³ , Mala Danylivka ³ , Mala Rohan ³ , Ruska Lozova ³ , Serpneve ³
Luhansk	–	Provallia ¹ , Vyshneve ²	Luhansk ³ , Rubizhne ³ , Seleznivka ³
Southern Ukraine			
Crimea	Malorichenske ² , Yalta ²	Alushta ² , Bakhchysarai ¹ , Masandra ² , Mostove ² , Nikita ² , Sevastopol ² , Sokolyne ² , Rozdolne ² , Cape Sarych ² , Cape Martyan Nature Reserve ²	Simferopol ³ , Haspra ³ , Kerch ³ , Koktebel ³ , Kostiantynivka ³ , Krasnokamianka ³ , Livadia ³ , Nekrasove ³ , Olenivka ³ , Okhotnykove ³ , Ordzhonikidze ³ , Perevalne ³ , Simeiz ³ , Sudak ³ , Yalta ³ , Yevpatoriia ³ , Mount Opuk ³
Kherson	Kherson ² , Cheresheve ² , Kostiantynivka ² , Oleshky ² , Sadove ²	Bilozerka district ¹	Kakhovka ³ , Krynyky ³ , Mala Oleksandrivka ³ , Velyki Kopani ³
Mykolaiv	–	Mykolaiv ¹	Pervomaisk ³ , Pokrovka ¹
Odesa	Odesa ¹ , Vilkov ² , Zmiinyi Island ¹	Odesa ¹	between Karolino-Buhaz and Zatoka ³ , Rozdilna district ³
Zaporizhzhia	Stepok ²	Zaporizhzhia ¹ , Berdiansk ¹ , Vasylivka ¹	Enerhodar ³ , Pryazovske ³ , Yakymivka district ³ , Yelyseivka ³