

A BRIEF OVERVIEW OF *CYDALIMA PERSPECTALIS* (Walker, 1859) (LEPIDOPTERA: CRAMBIDAE) DISTRIBUTION IN UKRAINE: EVIDENCE FROM PROFESSIONAL AND CITIZEN SCIENCE

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Короткий огляд поширення *Cydalima perspectalis* (Walker, 1859) (Lepidoptera: Crambidae) в Україні: свідчення професійної та громадянської науки. – Шпарик В.Ю., Заморока А.М. – Самшитова вогнівка – *Cydalima perspectalis* була завезена в Європу понад 10 років тому, а вже через кілька років вид був знайдений у 16 країнах континенту. Даний інвазійний шкідник завдає серйозної шкоди кущам різних видів самшиту (*Buxus sp.*), які активно використовуються в озелененні, у першу чергу для створення живоплотів. Наразі, інформація щодо інвазії цього виду на території України має фрагментарний характер. Поточне дослідження підсумовує відомості про поширення *C. perspectalis* в Україні, ґрунтуючись на даних наших оригінальних досліджень, опублікованих наукових праць та громадянської науки (онлайн баз біорізноманіття та спеціалізованих спільнот в соціальних мережах). Окрім того, ми вперше виявили імаго самшитової вогнівки у місті Івано-Франківськ та пошкоджені живоплоти самшиту. Ми розглядаємо два сценарії появи самшитової вогнівки в Україні. Перший сценарій – це проникнення шкідника із посадковими рослинами з Європейського Союзу та/або Китаю. Цей сценарій в основному стосується великих міст України. Другий сценарій – це вторинне природне розширення ареалу й інвазія *C. perspectalis* з Угорщини на територію Закарпаття та з Росії в Крим. Після виникнення стабільних локальних популяцій, вид швидко розпочав експансію, захоплюючи нові території. На нашу думку, *C. perspectalis* очевидно уже поширився на усю Україну. Проте дані, які б підтверджували це наразі відсутні. Наш аналіз показав, що самшитова вогнівка присутня в Чернівецькій, Дніпропетровській, Харківській, Херсонській, Київській, Львівській, Одеській, Полтавській, Закарпатській областях, АР Крим, ми також вперше виявили вид на території Івано-Франківської області, та суміжних регіонах Румунії (Сучава). Наші результати демонструють високу ефективність громадянської науки, як релевантного джерела відомостей для виявлення шкідників та інвазійних видів тварин.

Ключові слова: *Cydalima perspectalis*, інвазійні види, Україна, дані громадської думки.

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A brief overview of *Cydalima perspectalis* (Walker, 1859) (Lepidoptera: Crambidae) distribution in Ukraine: evidence from professional and citizen science. – Shparyk V.Yu., Zamoroka A.M. – The box tree moth *Cydalima perspectalis* was introduced in Europe more than 10 years ago. Several years later, the species was found in 16 countries of Europe, expanding its areal northward and eastward. In 2014 *C. perspectalis* was recorded in Ukraine at the first time. However, the data on its invasion in Ukraine are incomplete. The current study summarizes distribution of *C. perspectalis* in Ukraine, obtaining the available data from our original studies, published scientific papers and citizen science. We found the presence of the box tree moth in 11 regions of Ukraine and show the effectiveness of citizen science in the pest detection.

Key words: *Cydalima perspectalis*, invasive species, Ukraine, citizen science data

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Introduction

The box tree moth (*Cydalima perspectalis* (Walker 1859)) is an East Asian species introduced in Europe over decade ago. This alien moth causes severe damage to box trees (*Buxus sp.*) which is planted as ornamentals and typically used for hedges, and topiaries. The box tree moth infests the plants and distorts them by the defoliation and by the webbing spun by the larvae. Larvae feed on the leaves and the bark of the box trees. Plants become

dies soon after the bark was damaged by the pest (Baur et al. 2019).

To date, *C. perspectalis* is widely spread within Europe (except Norway and Finland), the Caucasus and spotted in Asia Minor, North Africa and North America (Baur et al. 2019). It is suggested the box tree moth was introduced in Europe with the shipment of plant material from East Asia. The most recent genetic phylogeography studies evident multiple introduction of the box tree

moth within Europe mainly from eastern China (Bras et al. 2019).

Currently, the box tree moth invaded natural *Buxus* populations in Mediterranean and the Caucasus regions. Dry broadleaved forest with box trees understorey widely spread in Southern Europe, North Africa, Asia Minor, the Caucasus and North Iran. Expansion of the box tree moth from urban landscapes into the wild is threatened natural *Buxus* forests. It is predicted the large forest areas of wild box trees will be lost and ecosystems changing will be occurred (Baur et al. 2019).

The first certain record of *C. perspectalis* in Ukraine is dated by 2014. It was found simultaneously in the several localities of Zakarpattia Region and Crimean Autonomous Republic (Turys 2015; Budashkin 2016). Nagy et al. (2017) suggesting that their record of *C. perspectalis* from Zakarpattia in 2016 was the first in Ukraine. However, it does not accord with the reality. In the following years the box tree moth was spotted in Kyiv and Kyiv Region (Budashkin 2016), and Odesa and its surroundings (Uzhevsk, Korytnianska 2018). Since, there are no native boxwoods in Ukraine, the invasion of box tree moth impacts mainly the urban landscaping.

The current study summarizes the distribution of *C. perspectalis* in Ukraine, obtaining the available data from our original studies, published scientific papers and citizen science. We found the presence of the box tree moth in 11 regions of Ukraine and show the effectiveness of citizen science in the pest detection.

Materials and methods

We studied spread of *C. perspectalis* in Ukraine, using our own records, and published scientific papers, and citizen science data. Our own data based on collected adult specimens and observation of damaged boxwoods on the east edge of Carpathian Mountains in Ukraine and Romania. We analysed all available records of *C. perspectalis* in Ukraine reported by citizen scientists on specialized sites and in social networks till to September 2019. We used data set accumulated on the website of Ukrainian Biodiversity Information Network (<http://ukrbin.com/>) which includes 20 records of the box tree moth within Ukraine. UkrBIN provides a facility for users to report occurrences of *C. perspectalis* with photographic supplements (UkrBIN 2019). We also used data set from the worldwide project iNaturalist which is a joint initiative of the California Academy of Sciences and the National Geographic Society (<https://www.inaturalist.org/>). We realized the web survey of the records on the box tree moth on the

public available specialized groups in social networks (mainly Facebook) including a public group of Ukrainian Entomological Society (<https://www.facebook.com/groups/ukrentov/>), and group of Ukrainian Biodiversity Information Network

(<https://www.facebook.com/groups/ukrbin.info/>), and group of Animal World of Ukraine (https://www.facebook.com/groups/tvarynnyy.svit.ukrayiny/?ref=group_header). We proved the correctness of the specimens identification provided by citizen scientists before including them to our study.

All incoming data were unified and transferred to electron table manager MS Excel from Office 2016 package. Arranged data were imported to the QGIS 2.18 for analysis and map preparation.

Results and discussion

To date *C. perspectalis* was known only from four regions of Ukraine, according to published scientific data (Turys 2015; Budashkin 2016; Uzhevsk, Korytnianska 2018; Lugina 2019). These include Crimea Region, Kyiv Region and Kyiv City, Odesa Region, Zakarpattia Region. Zakarpattia Region was the first Ukrainian territory where the box tree moth has been recorded in 2014 (Turys 2015). Almost at the same time it was found in Crimea (Budashkin 2016). However, the presence of this species in other regions of Ukraine is still unconfirmed.

Currently (01.09.2019) we found 3 specimens of the box tree moth (48.930533, 24.742082) and damaged boxwood hedges (48.918118, 24.719118) in city of Ivano-Frankivsk (Fig. 1). These records are the first for Ivano-Frankivsk Region in general. Additionally, on February 27, 2019 we occurred several damaged boxwoods by *C. perspectalis* in the Campus of Ștefan cel Mare University of Suceava (47.640975, 26.244174), Romania.

Clarifying the current distribution of the box tree moth in Ukraine, we used data of citizen scientists, who uploaded their own photos and descriptions of the target species to the publicly available web resources (see methods). Collated the data set accumulated on the website of UkrBIN and from social networks with our own data and published scientific papers we confirmed the presence of *C. perspectalis* in 11 of 25 Regions of Ukraine. These include, besides the five regions mentioned above, Chernivtsi Region, Dnipropetrovsk Region, Kharkiv Region, Kherson Region, L'viv Region and Poltava Region (Fig. 2).

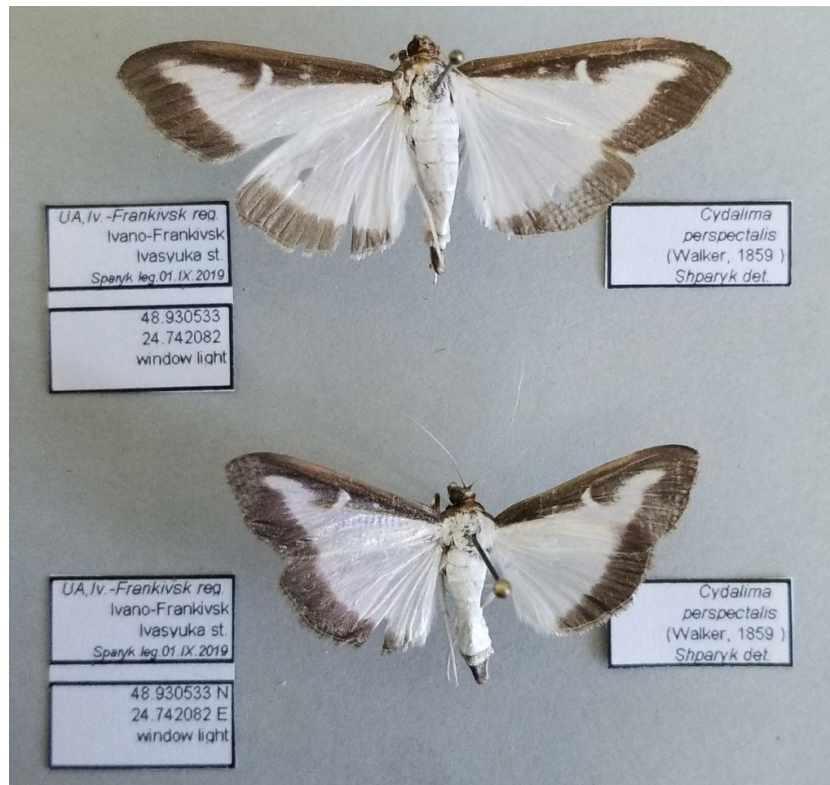


Fig. 1. Specimens of the box tree moth (*Cydalima perspectalis*) from Ivano-Frankivsk

Рис. 1. Екземпляри вогнівки самшитової (*Cydalima perspectalis*) зібрані в м. Івано-Франківськ

These findings display the high effectiveness of citizen science in the pest occurrence.

List of the citizen records of *C. perspectalis* is presented below:

UkrBIN: 1 spc. 15.08.2017, Nevsk str., Kyiv City (50.46112, 30.399553), Michael Smirnof; 1 spc. 07.08.2016, Korolevo, Zakarpattia Reg. (48.151833, 23.137822), Vasyl Gleba; 1 spc. 05.08.2018, 2 spc. 06.08.2018, Vynohradiv, Zakarpattia Reg. (48.15063245924809, 23.0295276589859), Vasyl Gleba; 1 spc. 31.08.2019, Kherson City (46.682979, 32.600774); Ruslan Mishustin; 1 spc. 28.06.2019, Obukhivka, Dnipropetrovsk Reg. (48.533609, 34.877899), Vika Roy; 1 spc. 01.09.2015, 2 spc. 05.09.2015, Knyazhychi, Kyiv Reg. (50.471091, 30.759047), Alexander Zykoy; 1 spc. 18.08.2019, Kharkiv City (50.047819, 36.199053), Andriy Khomenko; 1 spc. 31.08.2019, Trusha str., L'viv City (49.824838, 23.991277), Volodymyr Kramarets; 1 spc. 31.08.2019, L'viv City (49.834191, 24.03831), Genyk Golovko; 2 spc. 12.09.2017, Kyiv City (50.443826, 30.505714), Yuri Bengus; 1 spc. 01.08.2019, Pidryasne, L'viv Reg. (49.875095, 23.902589), Vitaliy Volyanyk; 1 spc. 10.08.2019, Solonka, L'viv Reg. (49.750509, 23.99928), Vitaliy Volyanyk; 1 spc. 05.08.2019, L'viv City

(49.833653, 24.026022), Vitaliy Volyanyk; 1 spc. 12.08.2019 L'viv City (49.826886, 23.967864), Vitaliy Volyanyk; 1 spc. 08.08.2019, Rysne-Ruske, L'viv Reg. (49.873314, 23.908405), Vitaliy Volyanyk.

The Facebook group of Ukrainian Entomological Society: 1 spc. 12.08.19, Chernivtsi City, (48.298200, 25.922236), Tetiana Makovey; 1 spc. 17.08.2019, Kharkiv City (49.986526, 36.236365), Ol'ga Pavlichenko; 1 spc. 05.09.2018, Rozhny, Kyiv Reg. (50.663848, 30.733383) Maryna Kameneva; 1 spc. 05.09.2018, Odesa City (46.467962, 30.735301), Valery D.; 1 spc. 18.04.2019, Pyrouy, Poltava Reg. (49.347510, 33.178325), Oksana Kalendar.

The Facebook group of Animal World of Ukraine: 1 spc. 20.03.2019, Hlevakha, Kyiv Reg. (50.257867, 30.301086), Tamara Trofimyshyna; 1 spc. 13.06.2017, Vystavkovyi Tsenter, Kyiv City (50.378917, 30.478735), Andrew Simon; 1 spc. 29.07.2018, Kyiv City (50.449157, 30.523248), Andrew Simon; 1 spc. 16.08.2017, Vasylkivska str., Kyiv City (50.383178, 30.479373), Elena Nisiniuk.

The Facebook group of Ukrainian Biodiversity Information Network: 1 spc. in May

2019, Pechenizka str., Kyiv City (50.467652, 30.488468), Olexander Piddubnyi.

iNaturalist: 1 spc. 21.06.2019 Kirov str., 82, Simferopol (44.957638, 34.108161), Ann Danilenko; 1 spc. 31.08.2019, Nemishayeve, Kyiv Reg. (50.563666, 30.097296), Prokopenko U.; 1 spc.

01.08.2019, Obolon, Kyiv City (50.500252, 30.506708), dima_r; 1 spc. 31.07.2018, Dniprovskiy, Kyiv City (50.471058, 30.582688), Rostyslav Gordon; 1 spc. 01.08.2019, Ushynskoho str., Kyiv City (50.436935, 30.451452), Kate Stonem.

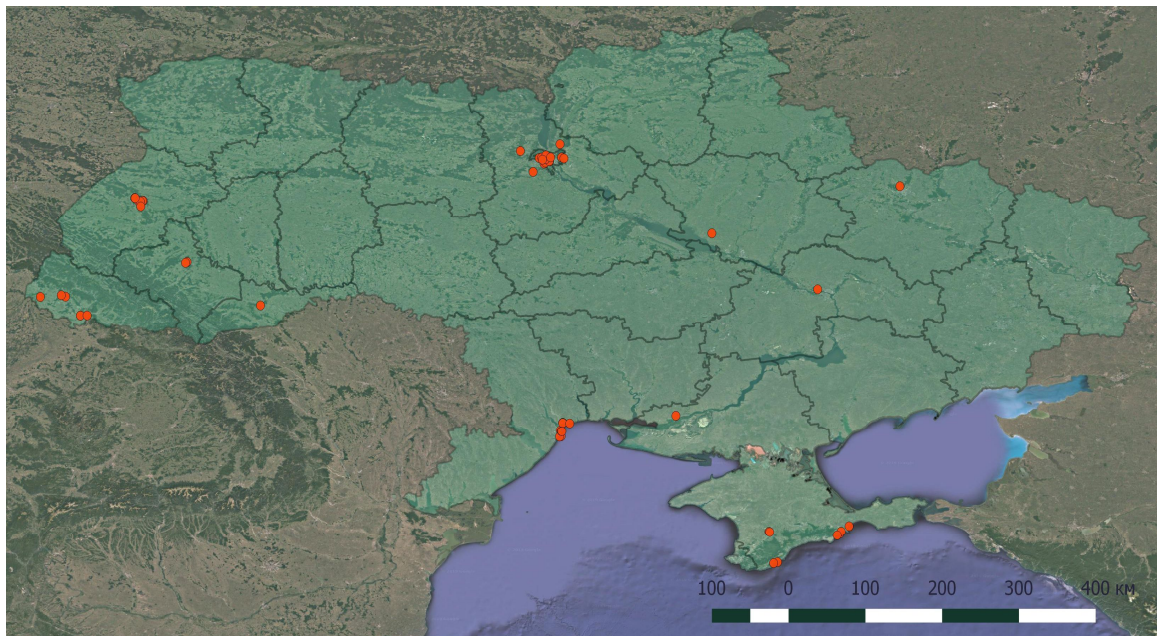


Fig. 2. Distribution map of the box tree moth (*Cydalima perspectalis*) in Ukraine

Рис. 2. Мапа поширення вогнівки самшитової (*Cydalima perspectalis*) в Україні

Analysis of gathered data shows that the box tree moth independently and simultaneously appeared in Ukraine around the 2014-2015 years at least in the three regions. These include Zakarpattia, Kyiv and Crimea. According to published scientific papers, *C. perspectalis* was recorded first in Zakarpattia in 2014 (Turys 2015) and then in Crimea in 2015 (Budashkin 2016). The first data on the box tree moth from citizen scientists appeared in 2015 for Kyiv Region. In all cases, the pest was abundant already and severe damaging of boxwood plants were observed (Turys 2015; Budashkin 2016). Thus we suggest that the pest was introduced/invaded several years early. The most plausibly it has taken the place between 2011-2013.

We are considering two scenarios of the box tree moth appearance in Ukraine. The first scenario is introducing the pest with the shipment of plant material from the European Union or China. This

scenario is mostly true for Kyiv and other large cities of Ukraine. The second scenario is an invasion of *C. perspectalis* from Hungary to Zakarpattia and from Russia to Crimea. After the stable local populations have established the species rapidly extended invading new territories. On our suggesting, *C. perspectalis* occupies all territory of Ukraine already.

Conclusions

In summary, we confirmed the presence of the box tree moth in 11 of 25 regions of Ukraine including Chernivtsi Region, Crimea Region, Dnipropetrovsk Region, Ivano-Frankivsk Region, Kharkiv Region, Kherson Region, Kyiv Region and Kyiv City, L'viv Region, Odesa Region, Poltava Region, and Zakarpattia Region. We displayed the high effectiveness of citizen science as a relevant source of data for the detection of the pest.

BAUR, B., JUNG, J., RUSTERHOLZ, H. (2019) Defoliation of wild native box trees (*Buxus sempervirens*): Does box rust (*Puccinia abuxi*) infection influence herbivory, survival and growth of

the invasive *Cydalima perspectalis*? *Journal of Applied Entomology*, 143: 766–775. doi:10.1111/jen.12640.

- BRAS, A., AVTZIS, D.N., KENIS, M., LI, H., VÉTEK, G., BERNARD, A., COURTIN, C., ROUSSELET, J., ROQUES, A., AUGER-ROZENBERG, M.A. (2019) A complex invasion story underlies the fast spread of the invasive box tree moth (*Cydalima perspectalis*) across Europe. *Journal of Pest Science*, 92: 1187–1202. doi.org/10.1007/s10340-019-01111-x.
- BUDASHKIN, Yu.I. (2016) Box wood moth –*Cydalima perspectalis* (Lepidoptera, Pyraustidae) – a new for the fauna of Ukraine and Crimea species of a dangerous pest of forestry and greenery. *Ecosystems*, 5: 36-39.
- LUGINA, S.V. (2019) Invasion of the box tree moth (*Cydalima perspectalis* Walker) in Kyiv: phenology, biological features, invasion / *Modern achievements of the natural sciences: Studied Research Practice Conference (for young scientists, students, undergraduates, graduate students)*. Poltava, 18-19, April, 2019, pp. 95–98.
- MITCHELL, R., CHITANAVA, S., DBAR, R., KRAMARETS, V., LEHTIJÄRVI, A., MATCHUTADZE, I., MAMADASHVILI, G., MATSIAKH, I., NACAMBO, S., PAPAZOVA-ANAKIEVA, I., SATHYAPALA, S., TUNIYEV, B., VETEK, G., ZUKHBAIA, M., KENIS, M. (2018) Identifying the ecological and societal consequences of a decline in *Buxus* forests in Europe and the Caucasus. *Biological Invasions*, 20: 3605–3620. doi:10.1007/s10530-018-1799-8.
- NAGY, A., SZARUKÁN, I., CSABAI, J., MOLNÁR, A., MOLNÁR, B.P., KÁRPÁTI, Z., SZANYI S., TÓTH, M. (2017) Distribution of the box tree moth (*Cydalima perspectalis* Walker 1859) in the north-eastern part of the Carpathian Basin with a new Ukrainian record and Hungarian data. *EPPO Bulletin*, 47(2): 279–282. doi:10.1111/epp.12384
- TURYS, E.V. (2015) Records and biological features of the development of the box tree moth *Cydalima perspectalis* (Walker, 1859) (Lepidoptera, Crambidae) in the Transcarpathian region of Ukraine. *Proceedings of the 15th International Scientific Conference "Uzhhorod Entomological Readings-2015"*, September, 25-27, 2015, pp. 81–82.
- UkrBIN (2019) UkrBIN: Ukrainian Biodiversity Information Network [public project & web application]. UkrBIN, Database on Biodiversity Information. Available from: <http://www.ukrbin.com> (Accessed: Date [e.g. September 03, 2019]).
- UZHEVSKA, S.P., KORYTNIANSKA, V.G. (2018) New records of *Cydalima perspectalis* (Lepidoptera, Crambidae) in the South of Ukraine. *Ukrainska entomofaunistyka*, 9(1): 5–7.