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RESEARCH ARTICLE

# To the knowledge of the fauna of pyraloid moths (Lepidoptera, Pyraloidea) of Belgorod Region

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## Abstract

We report the first faunal list of Pyraloidea of Belgorod Region, including 60 species of 46 genera, belonging to two families. *Phycita roborella* ([Denis & Schiffermüller], 1775), *Euzophera pinguis* (Haworth, 1811), *Cadra furcatella* (Herrich-Schäffer, 1849), *Cadra figulilella* (Gregson, 1871), *Pediasia contaminella* (Hübner, 1796), *Schoenobius gigantella* ([Denis & Schiffermüller], 1775) have been recorded for European Central Black Earth region for the first time. We collected the invasive boxwood pest *Cydalima perspectalis* (Walker, 1859) already registered in the territory of Belgorod region in 2022. In addition the results of testing traps with synthetic sex pheromone of *Ephestia elutella* (Hübner, 1796), including components (Z, E)-9,12-tetradecadienyl acetate and (Z, E)-9,12-tetradecadienol, are presented. 7 species of the Phycitini tribe attracted by this pheromone in the observed locality were recorded.

## Keywords

Belgorod Region, fauna, biodiversity, Pyralidae, Crambidae, pheromone trapping

## Introduction

Belgorod Region is located in the south of the Central Russian Upland in the basins of the Dnieper and Don rivers in the forest-steppe zone. According to the territorial division accepted in the Catalogue of the Lepidoptera of Russia (Sinev 2019), Belgorod Region is part of the European Central Black Earth Region along with Kursk, Lipetsk, Tambov, Orel, and Voronezh Regions. The lepidopterofauna of Belgorod Region is irregularly studied: there are publications about some families of Lepidoptera (Stekolnikov 1992, 1993; Sviridov, Tatarenko 2003; Sviridov 2003; Godin 2021; Godin, Matov, 2022, 2023, 2024a, 2024b), but many groups of the region remain uncovered, including pyraloid moths (Pyraloidea). There are records of Pyraloidea species for the European Central Black Earth region in general (Sinev et al. 2019; Sinev and Streltsov 2019), but there are no special studies devoted to the pyraloid moths of the Belgorod Region. We present the first list of Pyraloidea of Belgorod Region, based on collections in the Pulyaevka village during two years of research. In addition, the results of testing traps with the synthetic sex pheromone of *Ephestia elutella* were obtained and the spectrum of species attracted by this pheromone in the studied locality was determined.

## Materials and methods

The specimens were collected in Pulyaevka village of Belgorod district (50°27'7" N, 36°39'40" E) from June 14 to 21, 2022 and from June 14 to July 9, 2023 using a DRL-250 lamp hung over a screen made of a white sheet. The lamp was placed on a garden plot, which is bordered by such forest-steppe habitats as oak forest and adjacent forest edge biotopes, meadow biocenoses (Fig. 1), including those with natural chalk outcrops, and the Belgorod reservoir (Fig. 2), part of the shoreline of which is eroded and characterized by extensive reed thickets. In addition, six Delta pheromone traps were set on 0.3 ha between June 1 and July 9, 2023. (Fig. 3). The traps were produced by the All-Russian Plant Quarantine Center (FGBU "VNIIKR") and contained synthetic sex pheromone of *E. elutella*, including components – (Z, E)-9,12-tetradecadienyl acetate and (Z, E)-9,12-tetradecadienol.

Collected specimens were fixed and mounted using standard entomological methods. For identification of the majority of specimens, features of the genital structures were analyzed. Maceration of genitalia was performed in 10% KOH solution in Eppendorf-type tubes, which were placed in Biosan TDB-120 thermostat for 10 minutes at 70 °C. Images of specimens were taken with a Canon EOS 6D digital SLR camera with a Canon EF 100 mm f/2.8L IS USM macro lens, which was fixed on a Manfrotto tripod with a smooth motion along the axis of the optical system. A Canon Macro Ring Lite ring flash was used to evenly illuminate the specimens without glare. Images of the genitalia structures were taken using Zeiss StereoDiscovery V12 microscope with Canon EOS 6D camera. During photographing both genitalia and habitus, a series of frames were taken with different positions of the lens

focus point. The series of frames were stacked in a special focus-stacking program (Zerene Stacker) to obtain adequate depth of sharpness of the image. The images of habitus and genitalia were processed using Adobe Photoshop 2021 program.

All collected material was placed in the entomological fund of the All-Russian Plant Quarantine Center.

**Figure 1.** The vicinity of the collection locality. Grassy meadow.

## Results

We collected and identified 396 specimens of Pyraloidea belonging to 60 species (Table 1). 53 species were collected by light trapping only, 4 species by pheromone traps only, and 3 species were caught by both methods. 134 specimens belonging to seven species of the Phycitini tribe were collected by pheromone traps (Table 2).

**Table 1.** Pyraloidea, collected in the Pulyaevka village of Belgorod Region

| No | Taxa | Material examined |
|---|---|---|
| | PYRALIDAE | |
| 1 | *Lamoria zelleri* (De Joannis, 1932) | 1 ex., 20.06.2022; 1 ex., 21.06.2022; 3 exx., 14–16.06.2023; 1 ex., 7.07.2023; |
| 2 | *Lamoria anella* ([Denis & Schiffermüller], 1775) | 1 ex., 21.06.2022; 1 ex., 20.06.2022; 1 ex., 21.06.2022; 1 ex., 7.07.2023; |

| No | Taxa | Material examined |
|---|---|---|
| 3 | *Endotricha flammealis* ([Denis & Schiffermüller], 1775) | 1 ex., 20.06.2022; 8 exx., 7.07.2023; |
| 4 | *Hypsopygia costalis* (Fabricius, 1775) | 4 exx., 21.06.2022; 2 exx., 14–16.06.2023; 2 exx., 7.07.2023; |
| 5 | *Pyralis farinalis* (Linnaeus, 1758) | 9 exx., 21.06.2022; 1 ex., 14–16.06.2023; 2 exx., 7.07.2023; |
| 6 | *Trachonitis cristella* ([Denis & Schiffermüller], 1775) | 1 ex., 14.06.2022; |
| 7 | *Pempeliella ornatella* ([Denis & Schiffermüller], 1775) | 1 ex., 14.06.2022; |
| 8 | *Etiella zinckenella* (Treitschke, 1832) | 1 ex., 14.06.2022; 2 exx., 16.06.2022; |
| 9 | *Oncocera semirubella* (Scopoli, 1763) | 1 ex., 16.06.2022; 1 ex., 7.07.2023; |
| 10 | *Laodamia faecella* (Zeller, 1839) | 1 ex., 14.06.2022; 2 exx., 20.06.2022; 4 exx., 7.07.2023; |
| 11 | *Rhodophaea formosa* (Haworth, 1811) | 1 ex., 14.06.2022; 1 ex., 7.07.2023; |
| 12 | *Phycita roborella* ([Denis & Schiffermüller], 1775) | 2 exx., 7.07.2023; |
| 13 | *Acrobasis tumidana* ([Denis & Schiffermüller], 1775) | 1 ex., 7.07.2023; |
| 14 | *Acrobasis repandana* (Fabricius, 1798) | 1 ex., 14.06.2022; |
| 15 | *Acrobasis obtusella* (Hübner, 1796) | 1 ex., 20.06.2022; |
| 16 | *Glyptoteles leucacrinella* Zeller, 1848 | 1 ex., 20.06.2022; |
| 17 | *Myelois circumvoluta* (Fourcroy, 1785) | 2 exx., 18.06–9.07.2023 (by pheromone traps); |
| 18 | *Assara terebrella* (Zincken, 1818) | 1 ex., 19.06.2022; 1 ex., 7.07.2023; |
| 19 | *Euzophera fuliginosella* (Heinemann, 1865) | 1 ex., 20.06.2022; 3 exx., 7.07.2023; |
| 20 | *Euzophera pinguis* (Haworth, 1811) | 1 ex., 7.07.2023; |
| 21 | *Euzophera cinerosella* (Zeller, 1839) | 2 exx., 20.06.2022; 1 ex., 21.06.2022; 2 exx., 11–17.06.2023 (by pheromone traps); 1 ex., 18.06-9.07.2023 (by pheromone traps); |
| 22 | *Nyctegretis lineana* (Scopoli, 1786) | 1 ex., 7.07.2023; |
| 23 | *Homoeosoma sinuella* (Fabricius, 1794) | 1 ex., 11–17.06.2023 (by pheromone traps); |
| 24 | *Homoeosoma nebulella* ([Denis & Schiffermüller], 1775) | 1 ex., 7.07.2023; |
| 25 | *Ephestia elutella* (Hübner, 1796) | 1 ex., 19.06.2022; 2 exx., 20.06.2022; 1 ex., 14–16.06.2023; 51 exx., 11–17.06.2023 (by pheromone traps); 28 exx., 18.06–9.07.2023 (by pheromone traps); |
| 26 | *Plodia interpunctella* (Hübner, 1813) | 1 ex., 11–17.06.2023 (by pheromone traps); 9 экз, 18.06–9.07.2023 (by pheromone traps); |
| 27 | *Cadra furcatella* (Herrich-Schäffer, 1849) | 9 exx., 11–17.06.2023 (by pheromone traps); 1 ex., 14–16.06.2023; 19 exx., 18.06–9.07.2023; (by pheromone traps); |

| No | Taxa | Material examined |
|---|---|---|
| 28 | *Cadra figulilella* (Gregson, 1871) | 3 exx., 11–17.06.2023 (by pheromone traps); 8 exx., 18.06–9.07.2023 (by pheromone traps); |
| 29 | *Anerastia lotella* (Hübner, [1813]) | 1 ex., 19.06.2022. |
| | CRAMBIDAE | |
| 30 | *Calamotropha paludella* (Hübner, [1824]) | 4 exx., 7.07.2023; |
| 31 | *Chrysoteuchia culmella* (Linnaeus, 1758) | 3 exx., 19.06.2022; 14 экз, 7.07.2023; |
| 32 | *Crambus lathoniellus* (Zincken, 1817) | 1 ex., 13.06.2022; 1 ex., 19.06.2022; 6 exx., 14–16.06.2023; |
| 33 | *Crambus pascuellus* (Linnaeus, 1758) | 2 exx., 14.06.2022; 3 exx., 19.06.2022; 1 ex., 21.06.2022; 9 exx., 14–16.06.2023; 4 exx., 7.07.2023; |
| 34 | *Crambus pratellus* (Linnaeus, 1758) | 1 ex., 14.06.2022; 2 exx., 14–16.06.2023; |
| 35 | *Agriphila straminella* ([Denis & Schiffermüller], 1775) | 1 ex., 7.07.2023; |
| 36 | *Catoptria pinella* (Linnaeus, 1758) | 3 exx., 7.07.2023; |
| 37 | *Catoptria verellus* (Zincken, 1817) | 1 ex., 20.06.2022; |
| 38 | *Xanthocrambus saxonellus* (Zincken, 1821) | 1 ex., 14–16.06.2023; 1 ex., 7.07.2023; |
| 39 | *Pediasia luteella* ([Denis & Schiffermüller], 1775) | 1 ex., 20.06.2022; 3 exx., 19.06.2022; 7 exx., 7.07.2023; |
| 40 | *Pediasia contaminella* (Hübner, 1796) | 2 exx., 14–16.06.2023; 3 exx., 7.07.2023; |
| 41 | *Platytes cerussella* ([Denis & Schiffermüller], 1775) | 3 exx., 14.06.2022; 1 ex., 16.06.2022; 3 exx., 19.06.2022; 1 ex., 21.06.2022; 4 exx., 14–16.06.2023; |
| 42 | *Scoparia pyralella* ([Denis & Schiffermüller], 1775) | 1 ex., 16.06.2022; 2 exx., 7.07.2023; |
| 43 | *Scoparia ingratella* (Zeller, 1846) | 2 exx., 19.06.2022; 1 ex., 14–16.06.2023; |
| 44 | *Eudonia lacustrata* (Panzer, 1804) | 1 ex., 21.06.2022; 28 exx., 7.07.2023; |
| 45 | *Cynaeda dentalis* ([Denis & Schiffermüller], 1775) | 1 ex., 19.06.2022; |
| 46 | *Loxostege sticticalis* (Linnaeus, 1761) | 1 ex., 20.06.2022; |
| 47 | *Pyrausta aurata* (Packard, 1867) | 1 ex., 7.07.2023; |
| 48 | *Pyrausta sanguinalis* (Linnaeus, 1767) | 1 ex., 14–16.06.2023; 1 ex., 7.07.2023; |
| 49 | *Sitochroa verticalis* (Linnaeus, 1758) | 1 ex., 16.06.2022; 1 ex., 19.06.2022; 1 ex., 7.07.2023; |
| 50 | *Sclerocona acutella* (Eversmann, 1842) | 3 exx., 14.06.2022; |
| 51 | *Ostrinia scapulalis* (Walker, 1859) | 7 exx., 19.06.2022; 5 exx., 14–16.06.2023; 4 exx., 7.07.2023; |
| 52 | *Anania verbascalis* ([Denis & Schiffermüller], 1775) | 1 ex., 19.06.2022; 1 ex., 14–16.06.2023; 1 ex., 7.07.2023; |
| 53 | *Anania hortulata* (Linnaeus, 1758) | 3 exx., 19.06.2022; 2 exx., 14–16.06.2023; |
| 54 | *Patania ruralis* (Scopoli, 1763) | 2 exx., 7.07.2023; |
| 55 | *Cydalima perspectalis* (Walker, 1859) | 3 exx., 7.07.2023; |

| No | Taxa | Material examined |
|---|---|---|
| 56 | *Nomophila noctuella* ([Denis & Schiffermüller], 1775) | 5 exx., 14–16.06.2023; 2 exx., 7.07.2023; |
| 57 | *Schoenobius gigantella* ([Denis & Schiffermüller], 1775) | 1 ex., 14.06.2022; 1 ex., 20.06.2022; 1 ex., 7.07.2023; |
| 58 | *Donacaula forficella* (Thunberg, 1794) | 1 ex., 7.07.2023; |
| 59 | *Cataclysta lemnata* (Linnaeus, 1758) | 1 ex., 14–16.06.2023; 9 exx., 7.07.2023; |
| 60 | *Parapoynx stratiotata* (Linnaeus, 1758) | 1 ex., 14.06.2022. |

**Figure 2.** The vicinity of the collection locality. Belgorod reservoir.

**Table 2.** Species, collected by pheromone traps

| No | Species | Number of specimens |
|---|---|---|
| 1 | *Ephestia elutella* | 79 |
| 2 | *Cadra furcatella* | 28 |
| 3 | *Cadra figulilella* | 11 |
| 4 | *Plodia interpunctella* | 10 |

| No | Species | Number of specimens |
|---|---|---|
| 5 | *Euzophera cinerosella* | 3 |
| 6 | *Myelois circumvoluta* | 2 |
| 7 | *Homoeosoma sinuella* | 1 |

**Figure 3.** The Delta pheromone traps.

## Discussion

The seven Pyraloidea species we collected are not listed for the European Central Black Earth Region in the Catalogue of the Lepidoptera of Russia (Sinev et al. 2019; Sinev and Streltsov 2019). These species include *Phycita roborella* (Figs 4, 1), *Euzophera pinguis* (Figs 4, 2, 3), *Cadra furcatella* (Figs 7, 4–7), *Cadra figulilella* (Figs 7, 1–3), *Pediasia contaminella* (Figs 4, 4, 5), *Schoenobius gigantella* (Figs 5, 1), and the invasive boxwood pest *Cydalima perspectalis* (Figs 5, 2). *C. perspectalis* was first recorded in Belgorod Region in 2022, where it was apparently introduced with boxwood seedlings (Godin, Miroshnikov, Prisny 2022). The native range of *C. perspectalis* is located in the Eastern Palearctic, and in the 21st century the pest penetrated to Europe (Kruger 2008). Currently, *C. perspectalis* is actively spreading in southern Russia, where it was introduced from Italy (Streltzov et al. 2022). On July 7, 2023, we have caught 3 specimens by light trap.

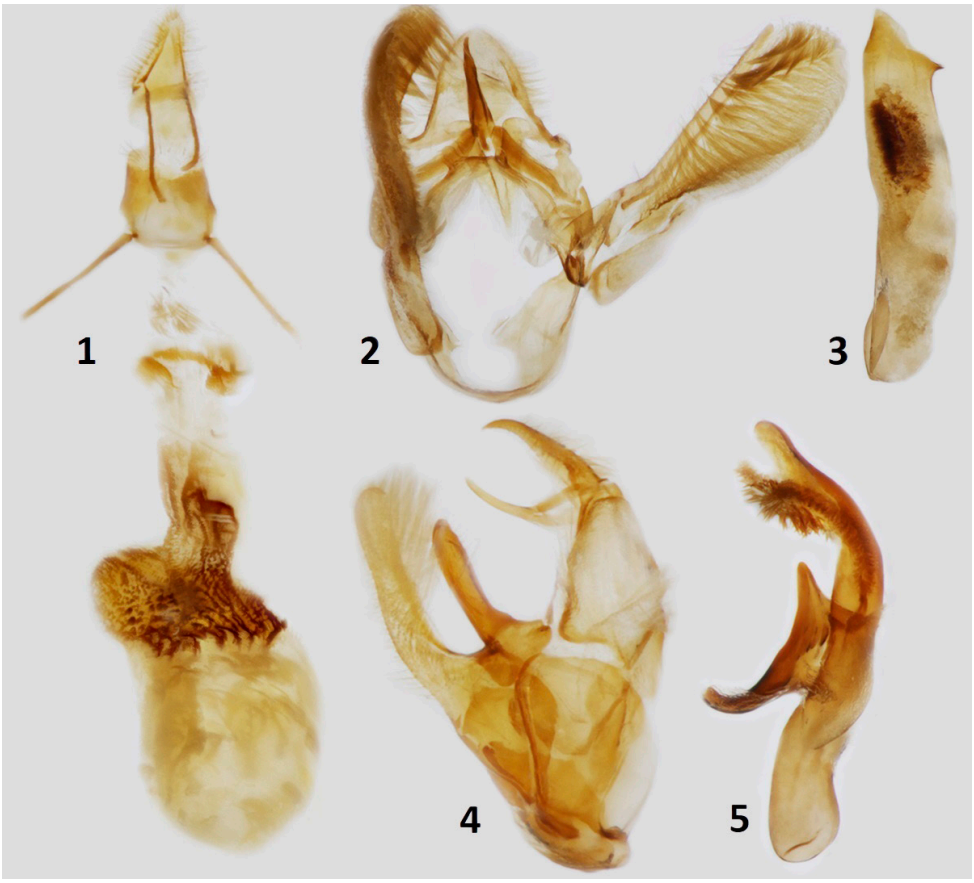


**Figure 4.** Genital structures of some Pyraloidea species, collected in Pulyaevka village of Belgorod Region. 1 – *Phycita roborella*; 2, 3 – *Euzophera pinguis*; 4, 5 – *Pediasia contaminella*. 1 – female genitalia, 2, 4 – male genitalia without aedeagus; 3, 5 – aedeagus.

179 species of Pyraloidea are listed for the European Central Black Earth Region in the Catalogue of the Lepidoptera of Russia, that together with our data totals 186 species. Thus, the number species we collected in Pulyaevka village amounted to 32% of the known Pyraloidea species composition of the European Central Black Earth Region.

Most of the specimens caught by pheromone traps belonged to *Ephestia elutella* (Figs 6, 1–3). This species feeds on grain and other stored products (Zagulyaev 1965). Other storage pests from the Phycitini tribe (such as *Ephestia kuehniella* Zeller, 1879, *Cadra cautella* (Walker, 1863), *Cadra calidella* (Guenée, 1845), *Cadra figulilella*, *Plodia interpunctella*) are known to have similar sex pheromones (Kuwahara, Casida 1973; Brower 1977; Soldan, Spitzer 1983; Buchelos, Levinson 1985; Carvalho et al. 2000; Athanassiou et al. 2010; Ding et al. 2021; The pherobase 2024). Reproductive isolation is realized by a short-range male pheromone as well as specific courtship behaviors (Takahashi 1973; Krasnoff, Vick 1984; Ashworth 1993).

We have caught by pheromone traps 11 specimens of *C. figulilella* (Figs 7, 1–3) and 10 specimens of *P. interpunctella* (Figs 6, 4, 5). *E. cinerosella* (3 specimens) (Figs 8, 1–3), *M. circumvoluta* (2 specimens) (Figs 8, 7, 8), and *H. sinuella* (1 specimen) (Figs 8, 4–6), recorded on pheromone traps, are not storage pests and feed on a various wild plants. The attraction of both components of this pheromone for *M. circumvoluta* has been previously reported (Attygalle et al. 1988). We could not find such information for *E. cinerosella* and *H. sinuella*, but the same pheromone components are known for the several other species in these two genera (Ma et al. 2014; The pherobase 2024). *Cadra furcatella* represented a significant proportion of individuals in traps (28 specimens). It is reported that its larvae feed on different kinds of organic debris (Falck et al. 2019). We observed *C. furcatella* mainly on a trap near a compost heap, which apparently provided a source for the development of this species. We could not find any data on the attraction of *C. furcatella* by this pheromone, and the results of our studies indicate that this pheromone is significantly attractive for mentioned species. Therefore, based on the above, it is possible to conclude that traps with synthetic sex pheromone of *E. elutella* can be successfully used as an additional method in faunistic studies.

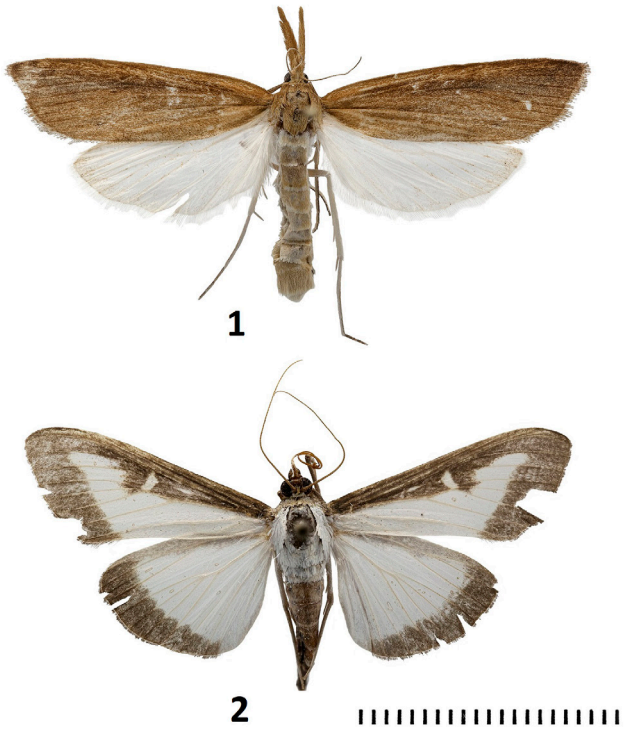


**Figure 5.** Crambidae species collected in Pulyaevka village of Belgorod Region. 1 – *Schoenobius gigantella*, 2 – *Cydalima perspectalis*. The graduation in the scale is 1 mm.


**Figure 6.** Male genital structures of Phycitini species collected by traps with synthetic sex pheromone of *Ephestia elutella* in Pulyaevka village of Belgorod Region. 1–3 – *Ephestia elutella*. 4, 5 – *Plodia interpunctella*. 1, 4 – general view of genitalia without aedeagus; 2, 5 – aedeagus; 3, – androconial scales.

## Conclusions

Thus, the first faunal list of Pyraloidea of Belgorod Region, including 60 species is reported. The list of Pyraloidea of the European Central Black Earth Region is supplemented with 7 species. Seven species of the Phycitini tribe in the studied locality were attracted by synthetic sex pheromone of *E. elutella*. Further research should significantly extend our knowledge about the composition of the regional fauna.


**Figure 7.** Male genital structures of Phycitini species collected by traps with synthetic sex pheromone of *Ephestia elutella* in Pulyaevka village of Belgorod Region. 1–3 – *Cadra figulilella*; 4–7 – *Cadra furcatella*. 1 – general view of genitalia without aedeagus; 4 – valva; 5 – tegumen and gnathos; 2, 7, – aedeagus; 3, 6 – androconial scales.


**Figure 8.** Male genital structures of Phycitini species collected by traps with synthetic sex pheromone of *Ephestia elutella* in Pulyaevka village of Belgorod Region. 1–3 – *Euzophera cinerosella*; 4–6 – *Homoeosoma sinuella*; 7, 8 – *Myelois circumvoluta*. 1, 4, 7 – general view of genitalia without aedeagus; 2, 5, 8, – aedeagus; 3 – androconial scales; 6 – valva.

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