FOREST AND AGRICULTURAL ECOSYSTEMS PESTS (LEPIDOPTERA), PRESERVED IN THE ENTOMOLOGICAL COLLECTIONS OF THE NATURAL HISTORY MUSEUM IN SIBIU (ROMANIA)

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Abstract. The presence of some Lepidoptera species that are pests of forest and agricultural ecosystems hosted within the Natural History Museum of Sibiu is presented herein. They have been used in research and some have been reported and results have been published. Fourteen species belonging to six Lepidoptera families (*Cossidae, Lasiocampidae, Pieridae, Notodontidae, Noctuidae,* and *Erebidae*) have been identified. Each species is presented with information about their geographic range, damage, and plants they affect, including the type of damage produced, as well as the number of specimens identified in the six studied collections (Daniel Czekelius, Eugen Worell, Viktor Weindel, Heinrich Hann von Hannenheim, Rolf Weyrauch, and Eckbert Schneider) within the Natural History Museum in Sibiu. The data presented have a historical value and show the relevance of the species that have been collected in the region for over 117 years. They are still present in the agricultural and forest ecosystems producing significant damages to several crops.

Keywords: *Lepidoptera*; ecosystems; collections; type of damage; species affected.

INTRODUCTION

This work is a contribution to the knowledge of Lepidoptera pest species that have been affecting crops, but also of the value of historical information contained about those species in the Natural History Museum in Sibiu, Romania (NHMS). The specimens in the NHMS have been collected between 1903-1984 mainly in Sibiu and its surroundings but also along with other places in Transylvania and Romania. To present the list below, the specimens were identified and their data collected from six entomological collections preserved in the NHMS. Only species of economical relevance in forests and agricultural ecosystems were studied.

The NHMS collection has been a source of information for numerous entomologists, lepidopterologists, and naturalists; and many of them have published their results with detailed data on many insects orders held there [6-9, 11, 15, 17-19, 20-30, 32, 33].

Several species of Lepidoptera considered pests of crops can be found in six collections within the NHMS. The *collection of Transylvanian Lepidoptera by Dr. Daniel Czekelius* which contains 14000 specimens, collected between 1880-1938. Unfortunately, some of the specimens do not have collecting data [23]. The next studied *Collection* was that of *Dr. Eugen Worell* with 11651 specimens of Lepidoptera collected in Sibiu and its surroundings between 1900-1958 [7].

The *Collection of Lepidoptera from Transylvania* of *Dr. Viktor Weindel* was then revised and it contains 4322 specimens collected between 1903-1964 also from Sibiu and its surroundings, but also other places in Transylvania [21, 32]. Over time, the Viktor Weindel collection has been thoroughly studied and interesting and important data have been published by the author of this works [6, 26-28], with species collected in Gușterița Hill, Hohe Rinne (Păltiniș), Cisnădie, Cisnădioara, and also in the Dumbrava Sibiului Forest [22, 23, 25].

Heinrich Hann von Hannenheim's collection of Lepidoptera was also studied and it contains 1900 specimens of Lepidoptera, collected between 1953-1964, mainly from the Southern Carpathians and the surroundings of Sibiu [11]. It was donated to the NHMS in 1964 and has been consulted over time by well-known specialists such as A. Popescu-Gorj, E. Schneider, L. Rákosy and L. Szèkely, to name a few [14-16, 20, 21, 29-31].

Also revised was *Rolf Weyrauch's entomological collection* includes 6043 specimens, collected between 1949-1978 with lepidopteran species collected from Transylvania, the surroundings of Sibiu (Dealul Gușteriței, Dealul Slimnicului, Măgura Cisnădiei, Cisnădioara, Pădurea Dumbrava Sibiului, Pasul Turnu Roșu), Southern, Eastern and Western Carpathians Mountains (Masivul Cozia, Băile Herculane), Dobrudja and the Danube Delta [11]. The catalog of his butterflies collection was published in 1984 by E. Schneider, a former student of his [20].

The *Collection of Eckbert Schneider*, the last used for this study has 6518 specimens between 1947 and 1984 and contain many identified lepidopterans that are harmful to crops. The researcher E. Schneider himself is currently working on the catalog of this collection.

These six relevant lepidopterological collections preserved at the NHMS are historically and documentarily important, and some of the gathered data is published here for the first time.

MATERIAL AND METHODS

After studying the six above mentioned collections, the identified pest species were discussed concerning their distribution worldwide and also in our country according to CABI.org. Also included is the type of

damage and if they affect crops or forest plants and plant preference of the larvae.

The number of specimens in every collection, collector's name, collecting site, and the data of collecting (day, month, and year) is mentioned for every species. However, some of this information is incomplete for some species/specimens since they are missing from the labels.

This study presents the list of identified species in a systematic order and follows the nomenclature for Romanian Lepidoptera of the *Catalogue of the Romanian Lepidoptera* [15] complemented with that of the European Lepidoptera [5]. The species of Lepidoptera harmful to agricultural and forestry agroecosystems are also presented according to the reference monograph: *Pests in the main agroecosystems and their integrated control* [13].

This is a systematic list identified species that were collected during 81 years. Besides the scientific names, they have also presented the popular denominations to be easier to identify the species by the people who work in the field of forestry and agriculture.

RESULTS

Family COSSIDAE

Cossus cossus (Linnaeus, 1758), (Ro 1853, K.&R. 4151)- Carpenter moth (Fig. 1)

Distribution. The latest CABI. org datasheets for 2020 confirms the presence of this species in 23 countries in Asia and 14 countries in Europe [34]. In Romania, the species is found from the plain to the mountains.

Type of damage and species affected. It is a polyphagous species that prefers fruit trees (*Malus* sp., *Prunus* sp.) but also ornamental trees (poplar, willow).

Material examined. *Dr. V. Weindel' s collection:* 10 specimens (Sibiu, 45°48'0.30"N, 24° 8'30.37"E)- June 4, June 7, 1904, June 10, 1922, July 12, 1922; (Râul Sadului, 45°34′11″N 23°56′14″E)- July 14, 1925 and five specimens with no labels.

Heinrich Hann von Hannenheim's collection: two specimens (Sibiu, at 45°48'0.30"N, 24° 8'30.37"E)- July 15, 1956, August 1, 1956.

Rolf Weyrauch's collection: eight specimens (Danube Delta, Crișan, at 45°10′48″N 29°21′05″E)- June 26, 1966 (2 specimens), July 3, 1976; September 6, 1970; (Eforie, at 44°4′N 28°38′E)- July 2, 1965; (Sulina, 45°9′34″N 29°39′10″E)- July 27, 1973; (Sibiu, at 45°48'0.30"N, 24° 8'30.37"E)- June 6, 1970 one specimen without data; (Sadu, at 45°41′09″N 24°10′48″E)- August 8, 1968.

Zeuzera pyrina (Linnaeus, 1761), (Ro 1867, K.&R. 4176) - Wood leopard moth, Leopard moth (Fig. 2)

Distribution. The latest data published by CABI.org. (2020) mentions the presence of the species in four countries in Africa, nine in Asia, 21 in Europe, and six countries in North America [35]. In Romania, the species is found both in the plains and in the mountains area.

Type of damage and species affected. This is a species reported in Romania attacking deciduous forests, but also fruit trees (*Malus* sp., *Pyrus* sp., *Prunus* sp.) orchards.

Material examined. *Dr. V. Weindel's collection*: two specimens Hohe Rinne (Păltiniș), at (45°39′10″N 23°55′55″E)- July 19, 1903; (Sibiu, at 45°48'0.30"N, 24° 8'30.37"E)- July 19, 1908.

Heinrich Hann von Hannenheim's collection: 2 specimens (Sibiu, at 45°48'0.30"N, 24° 8'30.37"E)- July 1963, one specimen without data.

Rolf Weyrauch's collection: 13 specimens (Someșul Rece, at 46°41′26″N 23°19′47″E)- July 20-22, 1976;

Figure 1. *Cossus cossus* L., 1758, in: **1.** *Dr. V. Weindel' s collection*; **2.** *Rolf Weyrauch's collection*

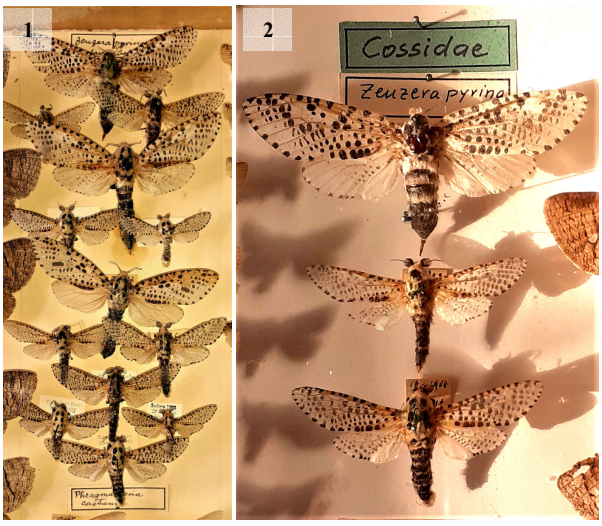

Figure 2. *Zeuzera pyrina L, 1761,* **1.** *Rolf Weyrauch's collection*; **2.** *Dr. V. Weindel's collection*

(Hagieni, at 43°47′2″N 28°28′48″E)- June 1962 (without the day of collecting)- June 11, 1973, July 7, 1973; (Sulina, at 45°9′34″N 29°39′10″E)- July 27-30, 1973; (Eforie Sud, at 4°1′30″N 28°39′10″E)- July 2, 1965; (Băile Herculane, at 44°52′43″N 22°24′51″E)- July 29, 1956, July 8,13, 1967, June 30, 1971, July 5, 1971, Vasile Roaită (Eforie), two specimens June 1961 without the day of collecting.

Family LASIOCAMPIDAE

Malacosoma neustria (Linnaeus, 1758), (Ro 3318, K.&R. 6743)- Lackey moth, Ring butterfly

Distribution. After CABI. org. (2020), the species is distributed in 36 countries in Europe, 12 countries in Asia and North America [36]. In Romania, the species can be found in forest-steppe zones and large groups in oak forests [14].

Type of damage and species affected. This is a polyphagous pest, defoliating fruit-bearing trees (apple, pear trees), decorative trees, but it also attacks forest species such as oak, elms, and lime-trees.

Material examined. *Dr. D. Czekelius's collection:* six specimens (Sibiu, at 45°48'0.30"N, 24° 8'30.37"E)- June 28, 1906, May 29, 1911, July 16, 1920, (three specimens) May 16, 1924; June 14, 1925.

Dr. V. Weindel's collection: ten specimens (Sibiu, at 45°48'0.30"N, 24° 8'30.37"E)- July 2, 1904; July 8, 1904; June 30, 1954; June 20, 1908; June 25, 1957; (Sibiu, the Hospital Garden Sibiu, at 45°48'0.30"N, 24° 8'30.37"E)- June 5, 1907.

Dr. Eugen Worell's collection: (Dumbrava Sibiului, at 45°45'37.57"N, 24° 7'34.38"E)- June 18, 1955.

Family PIERIDAE

Pieris brassicae brassicae (Linnaeus, 1758), (Ro 3476, K.&R. 6995)- Large white, Cabbage butterfly, Cabbage White, Large Cabbage White (Fig. 3)

Distribution. It is a common species in Africa (seven countries), Europe (53 countries), Oceania (one country), and Asia (45 countries) according to CABI.org [37]. It has been recorded from the plains to the mountain zone, between 0-1800 m. altitude, in Romania. It is a migratory species [30].

Type of damage and species affected. It is an oligophagous species; it attacks wild plants, but also crops in the family *Brassicaceae*, preferring cabbage and cauliflower. The young larva gnaws the epidermis and the parenchyma; after instars 3-4, the larvae spread on the leaves, gnawing the foliar limb, more frequent from the edge. In case of a strong attack, they gnaw completely the cabbage leaves, leaving only the main nervures [2].

When the plants are mature, the caterpillars gnaw the surface of the head of cabbage but do not make galleries inside it, unlike the larva of *Mamestra brassicae* [13].

Material examined. *Dr. D. Czekelius's collection:* three specimens (Sibiu, at 45°48'0.30"N, 24° 8'30.37"E)- May 17, 1911; (Păltiniș, at 45°39′10″N 23°55′55″E)- May 17, 1921; Chișineu (no data collection).

Dr. V. Weindel's collection: ten specimens (Dumbrava Sibiului, at 45°45'37.57"N, 24° 7'34.38"E)- August 1, 1903; May 21, 1904; (Guşterița Hill)- April 1920 (on the label it is not mentioned the day of collecting), (Guşterița Hill, at 45°48'41.56"N, 24°11'47.83"E)- July 27, 1921 9 (two specimens); (Măgura Cisnădiei, at 45°42'48.10"N, 24° 9'6.05"E)- May 22, 1921; (Borsec, at 46°58′0″N 25°34′12″E)- August 1, 1921.

R. Weyrauch's collection: seven specimens (Sibiu at 45°48'0.30"N, 24° 8'30.37"E)- September 1, 1992, June 9, 1964; (Băile Herculane, at 44°52′43″N 22°24′51″E)- May 10, 1967, July 7, 1963- (2 specimens); July 15, 1971; Vasile Roaită (Eforie), 1961 (on the label it is not mentioned the day of collecting).

Dr. E. Schneider's collection: one sample (Cluj, Lomb Forest)- July 27, 1966.

Pieris rapae (Linnaeus, 1758), (Ro 3478, K.&R. 6998)- Cabbage white, Cabbage butterfly (Fig. 4)

Material examined**.** *Dr. D. Czekelius' collection:* nine specimens (Sibiu, at 45°45'37.57"N, 24° 7'34.38"E)- July 29 (without the year of collection), July 19, 1908; (Bâlea, at 45.60335°N 24.61714°E)- August 5, 1908, August 28, 1911; (Brașov, at 45°39′N 25°36′E)- July 28, 1911; (Kuhhorn)- July 17, 1930; (Șureanu 2000 m)- July 4, 1932; (Cluj-Napoca, at 6°46′0″N 23°35′0″E)- April 13, 1930; (Guşterița at 45°48'41.56"N, 24°11'47.83"E)- July 20, 1934.

Figure 3. *Pieris brassicae brassicae* L., 1758, in collection of: **1.** R. Weyrauch, **2.** E. Schneider, **3.** Dr. D. Czekelius

Figure 4. *Pieris rapae* L., 1758, in: **1**. *Dr. D. Czekelius' collection* **2**. *Dr. E. Schneider's collection*

Dr. V. Weindel's collection: 23 specimens (Dumbrava Sibiului, at 45°45'37.57"N, 24° 7'34.38"E)- July 14, 1094, (Gușterița Hill, at 45°48'41.56"N, 24°11'47.83"E)- August 7, 1904, August 15, 1921, (three specimens) September 25, 1921, September 16, 1957; (Cisnădioara, at 45°42'21.17"N, 24° 6'24.74"E)- July 26, 1907; July 29, 1907 (Bâlea, at 45.60335°N 24.61714°E)- August 19, 1912; (Borsec, at 46°58′0″N 25°34′12″E)- August 1, 1921; (Cindrel Mountains)- August 2, 1922; August 4, 1922; (Păltiniș, at 45°39′10″N 23°55′55″E) (three specimens)- August 4, August 14, August 17, 1922, July 22, 1951; (Ocna Sibiului, at 45°52′54″N 24°03′41″E)- June 12, 1924; (Gheorgheni Valley, at 46°43′12″N 25°35′24″E)- July 12, 1954; (Cioara) October 9, 1955; (Râul Vadului, at 45°31′2″N 24°16′47″E)- July 20, 1958.

Dr. E. Schneider's collection: 26 specimens (Gușterița Hill, at 45°48'41.56"N, 24°11'47.83"E)- April 12, 1971; two specimens, October 4, 1974; four specimens (Costinești, at 43°56′50″N 28°37′47″E)- August 15-23, 1970; two specimens (Nochstenberg) April 10, 1971; June 27, 1979; (Hagieni, at 43°47′2″N 28°28′48″E)- April 28-29, 1971; two specimens (Iortmac Valley, at 44.22556°N 27.76167°E)- April 25-27, 1971; 2 specimens (Șiria, at 46°16′2″N 21°38′18″E)- June 6, 1960; (Făgăraș Mountains-Poiana Neamț) May 17, 1981; 2 specimens (Făgăraș Mountains- Doamnei Valley, 1450 m) August 4, 1984; (Slimnic-Zakels Hill, at 45°55′08″N 24°09′14″E)- August 10, 1970; (Retezat-Tăul Negru) August 8, 1974; (Mailați-Râul Sadu)- August 25, 1965; four specimens (Șura Mare, at 45°51′9″N 24°10′11″E)- April 12, 1972; June 23, 1973; (Cheile Dâmbovicioarei)- August 2, 1978; (Șeica Mare, at 46°1′29″N 24°9′25″E)- June 28, 1979; two specimens (Delta Dunării-C.A.Rosetti, at 45°17′23″N 29°32′35″E)- June 27, 1980; (Băile Herculane-Cerna Valley, at 44°52′43″N 22°24′51″E)- October 9, 1970.

Pieris napi napi (Linnaeus, 1758), (Ro 3480, K.&R. 7000)- Green-veined white butterfly (Fig. 5)

Material examined. *Dr. D. Czekelius's collection:* (Retezat, 1200 m)- July 15, 1929; two specimens (Retezat 1000 m)- July 26, 1928; (Retezat)- July 10, 1928; (Sibiu) April 20 (without the year of collection); (Cluj-Napoca, at 6°46′0″N 23°35′0″E)- April 12, 1922; (Fedelesch) May 31, 1909.

Dr. V. Weindel's collection: three specimens (Sibiu, Valea Aurie at 45°48'0.30"N, 24° 8'30.37"E)-April 26, 1904; two specimens (Măgura Cisnădiei at 45°42'48.10"N, 24° 9'6.05"E)- May 1,22, 1904; seven specimens (Dumbrava Sibiului at 45°45'37.57"N, 24° 7'34.38"E)- Aril, 1920; 2 specimens (Cisnădie at 45°42′47″N 24°9′32″E)-April 10, 1921, April 30, 1922; (Bătrâna Mountain)-July 5, 1925; (Gușterița at 45°48'41.56"N, 24°11'47.83"E)-April 30, 1950; (Gușterița Forest at 45°48'41.56"N, 24°11'47.83"E)- April 6, 1967, May 1, 1958; two specimens (Tălmaciu at 45°40′35″N 24°16′21″E)- May 25, 1958.

Dr. E. Schneider's collection: (Șiria, at 46°16′2″N 21°38′18″E)- June 16, 1960; three specimens (Șura Mare, at 45°51′9″N 24°10′11″E) two specimens-April 9, 1975, June 23, 1973; seven specimens (Gușterița Hill, at 45°48'41.56"N, 24°11'47.83"E)- April 19, 1970, August 1, 1970, April 4, 1971, four specimens June 20, 1971; (Turnu Severin, at 44°37′24″N 22°40′04″E)- March 15, 1975; (Vrancea Mountains-Lepșa Valley 1050 m)- June 11, 1974; seven specimens (Iortmac Valley, at 44.22556°N 27.76167°E)- April 25-27, 1971; two specimens (Făgăraș Mountains-Arpășel Valley)- July 27-30, 1976; (Cincu, at 45°54′52″N 24°48′13″E)- April 20, 1963; four specimens (Nochtsenberg)- June 8, 1964, April 10, 1971, July 7, 1971; April 11, 1978; (Cornățel, at 45°48′0″N 24°21′22″E)- April 24, 1983; two specimens (Poiana Neamț, at 46°54′11″N 26°11′4″E)- May 17, 1981, July 2, 1981; three specimen (Podul Olt,

at 45°39′43″N 24°17′55″E)- two specimen, August 5, 1970, June 21, 1979; eight specimens (Sibiel, at 45°45′58″N 23°54′29″E) (two specimens)- July 28, 1974, six specimens August 10, 1975; (Șeica Mare, at 46°1′29″N 24°9′25″E)- March 18, 1981; (Mihăileni, at 45°59′25″N 24°20′52″E)- May 4, 1917; (Sighișoara, at 46°13′1″N 24°47′28″E)- May 20, 1981; (Vrancea Mountains- Zboina Neagră 1250 m)- August 30, 1974; (Băile Herculane, at 44°52′43″N 22°24′51″E)- August 4-14, 1973; (Veștem, at 45°43′4″N 24°14′19″E)- June 24, 1980; five specimens (Sadu Valley, at 45°40′13″N 24°10′56″E)-July 8, 1980; (Băile Herculane-Cernei Valley, at 44°52′43″N 22°24′51″E)- July 9-10, 1970; three specimens (Porumbacu Valley, at 45°42′50″N 24°28′25″E)-August, 1982; (Râul Vadului, at 45°31′2″N 24°16′47″E)- September 7, 1981.

Figure 5. *Pieris napi napi* L., 1758, *E. Schneider's collection*

Family NOTODONTIDAE

Thaumetopoea processionea (Linnaeus, 1758), (Ro 4432, K.&R. 8689)- Oak processionary

Distribution. It is a species spread throughout Europe, in our country focuses with relatively reduced extensions were registered in Dobrudja, Muntenia, Oltenia, and Transylvania [2].

Natural enemies of the species. In our country they were registered virale epizooties and natural enemies, mainly the parasitoid Hymenoptera that regulate the density of the pest populations [12].

Material examined. *Dr. V. Weindel's collection*: two specimens (Sibiu, at 45°48'0.30"N, 24° 8'30.37"E)- August 16, September 5 (no collecting year mentioned).

Phalera bucephaloides (Ochsenheimer, 1810) (Ro 4483, K.&R. 8752)- The caterpillar with yellow and black stripes

Distribution. It is a common insect in the whole of Europe; in our country, there were recorded some attack zones in Dobrudja, Moldova, and Bucharest [13].

Type of damage and species affected. It is a polyphagous species, infesting the foliar apparatus of the oak, poplar, beech, lime-trees, and other species of deciduous trees. When the attack is strong, the caterpillars defoliate the trees.

Material examined. *Dr. D. Czekelius's collection:* five specimens (Râul Sadului, at 45°34′11″N 23°56′14″E)- May 18, July 25, July 28, 1925; two specimens (Sibiu, at 45°48'0.30"N, 24° 8'30.37"E)- June 13 (without the year of collection), July 1, 1903.

Dr. V. Weindel's collection: six specimens (Sibiu, at 45°48'0.30"N, 24° 8'30.37"E)- June 24, 1904 (two specimens); (Sibiu, the Hospital Garden, at 45°48'0.30"N, 24° 8'30.37"E)- June 13, 1907 (four specimens).

Dr. E. Worell's collection: one specimen (no data collection).

Family NOCTUIDAE

Mamestra brassicae (Linnaeus, 1758), (Ro 5080, K.&R. 9987)- Cabbage moth, Cabbage owl

Distribution. After the last data centralized by CABI.org, the species has been recorded in Africa, 25 countries in Asia, and 36 countries in Europe [38]. In Romania, it is a species frequently found from the steppe zone to the beech zone [13].

Type of damage and species affected. It is a polyphagous species, but it is more frequent *Brassica oleracea, Raphanus raphanistrum, Sinapis arvensis, Reseda lutea*, *Pisum sativum, Nicotiana tabacum, Dianthus* sp., *Chrysanthemum* sp., *Dahlia* sp. etc.

At the cabbage plants, the caterpillars gnaw the edge of the leaves, the inferior epidermis, and the parenchyma, then produce large perforations in leaves, up to the complete destruction of the leaves.

The heads of the cabbage are filled with galleries and excreta, their food value is depreciating and after the attack on install the pathogen agents that produce their putrefaction. The larvae from first generation attack the early cabbage and the summer cabbage; the larva of the second generation attack the cabbage crop of autumn [4]. The cabbage owl is a specific pest of the cabbage crops, and the related species and it could produce damages up to 80% [10].

Material examined. *Dr. D. Czekelius's collection:* four specimens (Sibiu, at 45°48'0.30"N, 24° 8'30.37"E)- May 15, 1918, May 16, 1919, April 26 (without the year of collection), May 20 (without the year of collection).

Dr. V. Weindel's collection: seven specimens (Sibiu center, at 45°48'0.30"N, 24° 8'30.37"E)- August 18, 1903; (Dumbrava Sibiului, at 45°45'37.57"N, 24° 7'34.38"E)- August 18, 1904; (Cisnădioara, at

45°42'21.17"N, 24° 6'24.74"E)- August 7, 1907; (Tălmaciu, at 45°40'0.00"N, 24°15'40.00"E)- August 23, 1910; (Sibiu, at 45°48'0.30"N, 24° 8'30.37"E)- June 20, 1954; (Gușterița, at 45°48'41.56"N, 24°11'47.83"E)- August, with label without the day and the year of collecting.

Agrotis segetum ([Denis & Schiffermüller], 1775, (Ro 5427, K.&R. 10351)- Turnip moth

Distribution. The 2020 data of CABI.org. recorded the presence of this species in 27 countries in Africa, 67 countries in Asia, and 48 countries in Europe [39]. In our country, the species can be found everywhere, but it has been mainly recorded in southern Romania [4].

Type of damage and species affected. It is a polyphagous species. The larvae gnaw the stems of the cultivated plants (cereals, maize, technical plants) species from spontaneous flora.

Material examined. *Dr. D. Czekelius's collection:* eight specimens (Sibiu, the coordinates 45°48'0.30"N, 24° 8'30.37"E) July 14, 1920, August 20, 1936, August 1,6,10,11,14, (without the year of collection); October 28 (without the year of collection).

Dr. V. Weindel's collection: six specimens (Sibiu-the Golden Valley, at 45°48'0.30"N, 24° 8'30.37"E)- May 20, 1904; (Dumbrava Sibiului, at 45°45'37.57"N, 24° 7'34.38"E)- August 18, 1904 (three specimens); (Cisnădioara)- August 18, 1907; (Gușterița, at 45°48'41.56"N, 24°11'47.83"E) on this label it is missing the day and the year of collecting.

Dr. E. Worell's collection: (Dumbrava Sibiului, at 45°45'37.57"N, 24° 7'34.38"E)- August 21, 1938.

Family EREBIDAE

Lymantria monacha (Linnaeus, 1758), (Ro 5440, K.&R. 10375)- Hairy caterpillar of the spruce-fir

Distribution. After the data centralized by CABI. org., the presence of this species has been recorded in 25 countries in Asia, 38 countries in Europe, and two states in North America [40]. In our country it appears in great populations frequently attacking coniferous forests, damaging their vegetation [2].

Type of damage and species affected. It is an oligophagous species, it infests the coniferous species, but it prefers the spruce-fir (*Picea* spp.) and the pine (*Pinus* spp.); their larvae were rarely recorded on deciduous trees species.

In the spruce-fir forests, the populations of larva install themselves in the pure, mature, and dense forests. In the pine forests, the focuses appear in the middle of the massif forests and their depressions.

Material examined. *Dr. D. Czekelius's collection:* six specimens (Râul Sadului, at 45°34′11″N 23°56′14″E)- September 20, 1920; July 15, July 28, August 10, September 12, 1925; September 1 (without the year of collection).

Dr. V. Weindel's collection: two specimens, July 19, 1907 (Măgura Cisnădiei)- July 14, 1908 (Cisnădie, at 45°42'48.10"N, 24° 9'6.05"E).

Lymantria dispar (Linnaeus, 1758), (Ro 5441, K.&R. 10376)- The hairy caterpillar of the oak

Distribution. The species is spread in 41 states in Europe, three countries in Africa, 35 countries in Asia, 48 states in the North America and New Zealand, according to the centralized data by CABI. org. [41]. In our country the species is present in all regions, more frequent it could be found in the zones with a continental climate: the North of Oltenia, Muntenia and Dobrudja, Banat, Crișana and Maramureș, existing in focuses mainly in the orchards of the proximity of the oak forests [12].

Type of damage and species affected. This is a polyphagous species, producing damages through the defoliation of the fruit-bearing trees (*Malus* sp., *Pyrus* sp., *Prunus armeniaca, Prunus persica*); the trees are no more fertile many years; the caterpillars bare the decorative trees and also the forest essences (*Quercus* sp., *Populus* sp., *Salix* sp., *Carpinus betulus, Acer platanoides*), defoliating them [13].

Material examined. *Dr. D. Czekelius's collection:* four specimens (Sibiu, at 45°48'0.30"N, 24° 8'30.37"E)- June 14, 1924; July 25, 1925, (Râul Sadului, at 45°34′11″N 23°56′14″E)- August 25, 1910, June 10, 1925.

Dr. V. Weindel's collection: 18 specimens (Sibiu, the Hospital Garden, at 45°48'0.30"N, 24° 8'30.37"E)- August 12, 1904; (Cisnădioara, at 45°42′16″N 24°6′46″E)- July 31, 1907; Augut 12, 1907, July 23, 1908; (Sibiu, at 45°48'0.30"N, 24° 8'30.37"E)- July 20, 1908; July 18-27, 1954 (eight specimens); August 7, 1954; August 16, 1955.

Euproctis chrysorrhoea (Linnaeus, 1758), (Ro 5459, K.&R. 10405)-The butterfly with the golden tip of the abdomen

Distribution. It is a species found in Europe, Minor and Oriental Asia, North Africa, and North America. In our country is frequently found in oak forests [1].

Type of damage and species affected. It is a polyphagous species, defoliating the fruit-bearing trees (apple, pear, apricot trees, and plum trees), the decorative trees, the elm and the oak trees.

Material examined. *Dr. D. Czekelius's collection:* two specimens (Romania); June 26, 1918, 1921 (without the day, month and place of collection), (Sibiu, at 45°48'0.30"N, 24° 8'30.37"E)- July 8, 1925, 10 July (without the year of collection).

Dr. E. Worell's collection: 17 specimens (Dumbrava Sibiului, at 45°45'37.57"N, 24° 7'34.38"E)- July 2, July 6, 1953; (Sibiu, at 45°48'0.30"N, 24° 8'30.37"E)- July 10, 1939, July, 1939 (without collecting day), July 1940 (without collecting day), July 15, 1956, 11 specimens (no data of collecting).

Dr. V. Weindel's collection: nine specimens (Sibiu center, at 45°48'0.30"N, 24° 8'30.37"E)- July 1, 1903 (5 specimens); July 2, 1903; (Sibiu, at 45°48'0.30"N, 24° 8'30.37"E)- July 12, 1954; July 12, 1954; August 4, 1956.

Penthoptera morio (Linnaeus, 1767), (Ro 5462, K.&R. 10408)- Black caterpillar of pasture lands and hay fields

Distribution. Invasions in the Mureş, Prahova, Hunedoara, Cluj, and Bihor counties have been reported in Romania [13].

Type of damage and species affected. The caterpillars attack Gramineae in pasture lands and hay fields, eating away the foliar limbs. In case of a strong attack, only the thick stems remain. In Autumn, after destroying the grasses from pastures and meadows, the larvas attack cereal crops from proximity. The larvae migrate and they feed on especially in the evening [13].

Material examined. *Dr. D. Czekelius's collection:* five specimens (Sibiu, at 45°48'0.30"N, 24° 8'30.37"E)- May 13, 1908; July 3, 1912; May 1, 1921; June 15, 1931; June 7, 1932.

Dr. V. Weindel's collection: ten specimens, (Sibiu, at 45°48'0.30"N, 24° 8'30.37"E)- June 22, 1904; Valea Aurie June 21, 1904; June 26, 1904; (Târnăvioara, at 46°19′47″N 24°17′12″E)- May 14, 1922 (two specimens); (Ocna Sibiului, at 45°52′54″N 24°03′41″E)- June 4, 1924 (three specimens); (the Obrejii Hill) June 19, 1951; (Măgura Cisnădiei, at 45°42'48.10"N, 24° 9'6.05"E)- June 13, 1954.

DISCUSSIONS

After gathering data from the above-mentioned entomological collections deposited in the NHMS, we have identified 14 species of Lepidoptera pests able to affect agricultural, forest, and orchard ecosystems.

The importance of these pests for Romania has been mentioned over time by several researchers [1-3, 12, 13], who have studied biology, ecology, ethology, type of damage, and has been also able to propose methods to diminish or control their populations. These are pests of worldwide relevance and most are cosmopolitan and affecting many different crops and forest plants [34-41].

Six families of Lepidoptera pests (*Cossidae*, *Lasiocampidae, Pieridae, Notodontidae, Noctuidae,* and *Erebidae*) were identified among the revised collections. The family *Erebidae* contains the most number of pest species found: four species. Three species were found among the *Pieridae*, while *Noctuidae, Cossidae,* and *Notodontidae* have two species, respectively. Only the Lasiocampidae family has one species represented in the collections under study.

The presented material is of historical relevance since it has been collected over a long period that expands more than 81 years, between 1903 and 1984. It also shows not only species that have been affecting crops and forest plants but their distribution over nine geographical regions of Romania.

The data existing in the studied collections bring completions to the collecting period and the distribution of the species of Lepidoptera that produce damages on the agricultural crops in Romania on the nine geographical regions as folows: Banat, Bucovina, Crişana, Dobrudja, Maramureş, Moldavia, Muntenia, Oltenia and Transylvania.

Specimens of *Cossus cossus* appears with collecting data from 1904 to 1976, comparatively with study years 1981-2001 in the paper of reference [15], where it was found in the following geographical regions, Banat, Transylvania, Muntenia, Moldavia, Maramureş, and Dobrudja. Crişana and Oltenia [15] mentioned it from a period between 1901 to 1980. This is a very common species.

Zeuzera pyrina was frequently collected during the period 1903-1976. According to Rákosy *et al*. [15], the species appears in Banat, Transylvania, Muntenia, Moldavia, Maramureş, and Dobrudja, but during the years 1900-1980, only in Crişana and Oltenia [15] cite the species. Specimens collected in 1903 and present in Weindel's collection originated from Hohe Rine (Păltiniş)- Cibin Mountains. This is a common species.

Malacosoma neustria which is in Czekelius's, Worell's, and Weindel's collections was collected between the years 1904-1957. The species is quoted in the paper of reference [15], in all nine geographical regions of Romania, but between the years 1901-1980 is quoted only in Crişana and Oltenia. In the years 1981-2001 is quoted in Banat, Transylvania, Muntenia, Moldavia, Maramureş, and Dobrudja. It is a species near threatened (NT) [15].

The Family *Pieridae* has three representative species in this work: *Pieris brassicae brassicae*, *P. rapae,* and *P. napi napi*, are found in all regions of Romania. They are common species affecting vegetable crops but also wild plants (*Reseda lutea, Tropeolum* sp., *Lepidium* sp., *Arabis* sp., *Allaria* sp.). The species *Pieris brassicae brassicae* is considered a vulnerable species (VU) because of pollution and climate change [30].

Phalera bucephaloides was found between 1850-1900 in Transylvania [15], between 1901-1980 in Crişana, Oltenia, Moldavia, and between 1981-2001 in Banat, Muntenia, and Dobrudja. Specimens were found in three of the collections revised for this study: Czekelius's, Worell's, and Weindel's with collecting years oscillating from 1903 to 1925. It is a near threatened taxon (NT) [30].

Phalera bucephaloides Ochsenheimer, 1810 was quoted between 1850-1900 in Transylvania [15], between 1901-1980 in Crişana, Oltenia, Moldavia and between 1981-2001 in Banat, Muntenia and Dobrudja. The species identified in three collection: Czekelius's, Worell's and Weindel's, collected between the years 1903-1925. It is a near threatened taxon (NT) [30].

Mamestra brassicae is a common species in most of Europe [38] and has been reported in all nine geographical regions in Romania [15]. It was found in Czekelius's and Weindel's collections; the collecting period was between the years 1903-1954.

Agrotis segetum is distributed over all in Romania. We found it in the following collections: Czekelius's, Worell's, and Weindel's, and specimens were collected

between 1904 and 1938. It is a common species not only in Romania but also in all of Europe [39].

Lymantria monacha was reported [15] between 1901 and 1980 only in Crișana and Oltenia, and between 1981-2001 in Banat, Transylvania, Maramureș, Muntenia, Moldavia, and possibly in Dobrudja. In Czekelius's and Weindel's collections, there are specimens collected between 1907 and 1925. This is a common species in Europe [41].

Lymantria dispar is a common species in all nine geographical regions of Romania. The specimens in Czekelius's and Weindel's collections were collected between 1904 and 1955.

Euproctis chrysorrhoea is a common and cosmopolitan species distributed all over our country [1]. Specimens are found in Czekelius's, Worell's, and Weindel's collections, dated 1918 to 1956.

Penthoptera morio has been reported all over Romania [13]. In the Czekelius's and Weindel's collections there is collected between 1904-1954. This is near threatened (NT) taxon [30].

According to the reference [15] all species studied here were recorded in Transylvania. However, the species preserved in the six above mentioned entomological collections hosted in the Natural History Museum in Sibiu, can still be found and affecting agricultural ecosystems and deciduous and coniferous forests scattered around the territory of Romania.

Acknowledgements. I am grateful to Mrs. Ana-Maria Păpureanu and Mrs. Ghizela Vonica, for their assistance in consulting the Lepidoptera collections, and also to Mr. Sergiu Török, Ph.D specialist in Lepidoptera and Mr. Ioan Tauşan, Ph.D for the unconditional support.

REFERENCES

[1] Baicu, T., Săvescu, A., (1986): Sisteme de combatere integrată a bolilor și dăunătorilor pe culturi. Ceres Press, Bucharest, 220 p.

[2] Boguleanu, G., (1994): Fauna dăunătoare culturilor agricole și forestiere din România II. Tehnică Agricolă Press, Bucharest, 576 p.

[3] Ciochia, V., Moise, C., (2005): Protecția ecologică a plantelor de cultură și mediul înconjurător, Pelecanus Press, Brașov, 181 p.

[4] Ghizdavu, I., Pașol, P., Pălăgesiu, I., Bobîrnac, B., Filipescu, C., Matei, I, Georgescu, T., Baicu, T., Bărbulescu, A., (1997): Entomologie agricolă, Didactic and Pedagogical Prees, București, 432 p.

[5] Karsholt, O., Nieukerken E.J., (2013): Lepidoptera, Moths. Fauna Europaea version 2.6, http://www.faunaeur.org accessed on August, 2020.

[6] Moise, C., (2011): Study on the Macrolepidoptera Collected from the Dumbrava Sibiului forest existing within the Collection of Dr. Viktor Weindel. Muzeul Olteniei Craiova, Studii şi comunicări, Ştiinţele Naturii, 27(2): 96-104.

[7] Moise, C., (2011): Lepidoptera (Insecta: Lepidoptera) in the Collection of Eugen Worell from Natural History Museum of Sibiu, collected from "Dumbrava Sibiului" forest. In: Lucrări ştiinţifice, seria Horticultură, "Ion Ionescu la Brad" Iaşi, 54(2): 571-576.

[8] Moise, C., (2011): Lepidoptera (Insecta: Lepidoptera) in the collection of Daniel Czekelius from Natural History Museum of Sibiu, collected from "Dumbrava Sibiului" Forest, Romania. Analele Universității din Oradea, Fascicula Biologie, 18(2): 104-110.

[9] Moise, C., (2011): Study on contributions to the knowledge of the fauna siebenbürger saxons of lepidoptera in siebenbürger and around Sibiu, entomology collections of the Museum of Natural History in Sibiu. In: 18th International Economic Conference IECS. Lucian Blaga University of Sibiu Press, pp. 179-187.

[10] Moise, G., (2014): Promotion of ecologic product certification as instrument to speed up the ecologic agriculture. Scientific Papers Series-Management, Economic Engineering in Agriculture and Rural Development, 14(1): 241-244.

[11] Pascu, M., Schneider, E., (1998): Colecţiile entomologice ale Muzeului de Istorie Naturală din Sibiu. Studii şi Comunicări, Ştiinţe Naturale Muzeul Brukenthal Sibiu, 27: 201-218.

[12] Perju T., (2002): Dăunătorii organelor de fructificare și măsuri de combatere integrată. vol. II Plante lemnoase. AcademicPres, Cluj-Napoca, 313 p.

[13] Perju, T., (2004): Dăunătorii din principalele agroecosisteme și combaterea lor integrată. AcademicPres, Cluj-Napoca, 496 p.

[14] Popescu-Gorj, A., (1970): 100 de ani de cercetări lepidopterologice în cadrul Societăţii Ardelene de Ştiinţe Naturale. Studii şi Comunicări, Muzeul Brukenthal Press, Sibiu, 15: 85-97.

[15] Rákosy, L., Goia, M., Kovács, Z., (2003): Verzeichnis der Schmetterlinge Rumäniens. Catalogul lepidopterelor din România. Romanian Lepidopterological Society Press, Cluj-Napoca, 446 p.

[16] Schneider, E., Stamp, H.M., (1970): Societatea Ardeleană de ştiinţe Naturale în cei 100 de ani de existenţă. Studii şi Comunicări, Muzeul Brukenthal Press, Sibiu, 15: 37-68.

[17] Schneider-Binder, E., (1971): Pajiștile xeromezofile din Depresiunea Sibiului și colinele ei marginale. Studii și Comunicări Ştiinţele Naturii. Muzeul Brukenthal Press, Sibiu, 16: 135-172.

[18] Schneider-Binder, E., (1972): Gebusche und Hecken (*Prunion fruticosae* Tx. 1952 und *Prunion spinosae* Soo (1930 n.n. 1940) im Hugelgebiet um die Zibinssenke in Siebenburgen. Studii și Comunicări Ştiinţele Naturii. Muzeul Brukenthal Press, Sibiu, 17: 183-207.

[19] Schneider-Binder, E., (1973): Pădurile din depresiunea Sibiului și dealurile marginale. Studii și Comunicări Ştiinţele Naturii. Muzeul Brukenthal Press, Sibiu, 18: 71-100.

[20] Schneider, E., (1984): Die Gross-schmetterlinge der Sammlung "Dr. V. Weindel" – Ein Beitrag zur Faunistik der Lepidopteren Südsiebenbürgens und angrenzender Gebiete. Studii şi Comunicări, Ştiitele Naturii. Muzeul Brukenthal Press, Sibiu, 26: 289-316.

[21] Schneider, E., (1996): Zur Schmetterlingsforschung in Hermannstadt in den Jahren 1945-1985. Stapfia Press, Viena, 45: 357-379.

[22] Stancă-Moise, C., (2002): The entomologists from Sibiu their contribution to the knowledge of the Lepidopterofauna of Sibiu-Surroundings collections. Lepidoptera. Macrolepidoptera. Analele Stiintifice ale Universității "Al. I. Cuza" Iași. Secțiunea I Biologie Animală. Alexandru Ioan Cuza University Press, Iași, 48: 7-12.

[23] Stancă-Moise, C., (2012): Macrolepidopterele din Pădurea Dumbrava Sibiului. Lucian Blaga University of Sibiu Press, 271 p.
[24] Stancă-Moise, C., (2014): Controlul populațiilor de dăunători. Lucian Blaga University of Sibiu Press, 224 p.
[25] Stancă-Moise, C., (2015): Lepidoptera collected from Dumbrava Sibiu forest, preserved in collections of Museum of Natural History in Sibiu. Analele Universității din Oradea, Fascicula Biologie, 22(2): 81-95.
[26] Stancă-Moise, C., (2017): Study on the Macrolepidoptera Collected from Păltiniș (Sibiu County), existing within the Collection of Dr. Viktor Weindel. Oltenia. Studii şi comunicări. Ştiinţele Naturii. Muzeul Olteniei Craiova, 33(2): 97-101.
[27] Stancă-Moise, C., (2018): The species of macro-lepidoptera collected from the Gușterița Hill, Sibiu, existing within the collection of dr. Viktor Weindel. Oltenia. Studii şi comunicări. Ştiinţele Naturii. Muzeul Olteniei Craiova, 34(2): 131-136.
[28] Stancă-Moise, C., (2019): Specii de lepidoptere colectate din Cisnădioara și Cisnădie, județul Sibiu, existente în cadrul colecției dr. Viktor Weindel. Oltenia. Studii şi comunicări. Ştiinţele Naturii. Muzeul Olteniei Craiova, 35(2): 114-120.
[29] Székely, L., (2003): Istoricul cercetărilor lepidopterologice din sud-estul Transilvaniei. Lucrările celei de a 6-a Conferinţe Naţionale pentru Protecţia Mediului prin Metode şi Mijloace Biologice şi Biotehnice şi a celei de a 3-a Conferinţe Naţionale de Ecosanogeneză. Pelecanus Press, Braşov, pp. 318-322.
[30] Szèkely, L., (2008): The Butterflies of Romania – Fluturii de zi din România. Brastar Print Press, Braşov, 304 p.
[31] Székely, L., (2014): Istoria Lepidopterologiei din România. Brastar Print Press, Brașov, 297 p.
[32] Vlad-Antonie, I., Ciobanu, R., (2004): Der Arzt Viktor Weindel als Insektenkundler (1887-1966), Siebenbürgisch Sächsische Naturwissenschaftler. Lucian Blaga University of Sibiu Press, pp. 139-143.
[33] Worell, E., (1951): Contribuţii la cunoaşterea faunei coleopterelor şi lepidopterelor din Transilvania, mai ales din împrejurimile oraşului Sibiu. Academia Republici Populare Romane, Buletin Ştiinţific Secţia Ştiinţe Biologice Agronomie Geologie Geografie Bucureşti, 3(3): 533-543.
[34] https://www.cabi.org/isc/datasheet/15523, accessed on August, 2020.
[35] https://www.cabi.org/isc/datasheet/57497, accessed on August, 2020.
[36] https://www.cabi.org/isc/datasheet/32328, accessed on August, 2020.
[37] https://www.cabi.org/isc/datasheet/41157, accessed on August, 2020.
[38] https://www.cabi.org/isc/datasheet/8491, accessed on August, 2020.
[39] https://www.cabi.org/isc/datasheet/3797, accessed on August, 2020.
[40] https://www.cabi.org/isc/datasheet/31811, accessed on August, 2020.
[41] https://www.cabi.org/isc/datasheet/31807, accessed on August, 2020.

Received: October 18, 2020
Accepted: December 11, 2020
Published Online: December 18, 2020
Analele Universităţii din Oradea, Fascicula Biologie
http://www.bioresearch.ro/revistaen.html
Print-ISSN: 1224-5119
e-ISSN: 1844-7589
CD-ISSN: 1842-6433
University of Oradea Publishing House