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Grażyna WINIARSKA

## Long-term changes in communities of *Noctuidae*, *Pantheidae* and *Nolidae* (*Lepidoptera*) of Warsaw city centre<sup>1</sup>

**Abstract:** In the centre of Warsaw 209 species of noctuid moths (*Noctuidae*, *Pantheidae* and *Nolidae*) were recorded, accounting for about 69% of all species ever found in this agglomeration. Only 15 species were classified as very abundant or abundant while as many as 174 were few and single. The following species were the most abundant: *Xestia c-nigrum*, *Autographa gamma*, *Discestra trifolii*, *Mythimna pallens*, *M. l-album*, *Agrotis exclamationis*, *A. segetum*, *Hoplodrina ambigua* and *Luperina testacea*. These species occurred abundantly everywhere. They are chiefly associated with open-area habitats (including anthropogenic ones). Noctuid communities in the centre of Warsaw have changed considerably over the last 50 years. The most abundant species have remained a constant element but rare (few and single) species have begun to disappear from the city centre, probably as a result of unfavourable environmental changes due to intensive urbanization of this area.

**Key words:** *Noctuidae*, *Pantheidae*, *Nolidae*, *Lepidoptera*, urban habitats, big city centre, Warsaw, strong settlement pressure

**Author's address:** Museum and Institute of Zoology PAS, Wilcza 64, 00-679 Warszawa, POLAND

### INTRODUCTION

The town is a human creation. Contemporary cities are a common element of landscape in many regions of our planet. Increasing urbanization induces a number of changes in the environment that have a restrictive effect on the occurrence of most plant and animal species in areas subjected to these impacts. However, for many other species, especially insects, urban habitats afford agreeable possibilities for development.

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The warmer and more arid urban microclimate is accompanied by a large number of "new" ecological niches, unstable ecological relations between immigrant species and those well-established, temporarily or permanently, in the urban habitat (both facing little competition and less severe pressure from predators and parasitoids), ample feeding resources and the spatial patchiness of urban environments (CHUDZICKA, SKIBIŃSKA & WINIARSKA 1998).

Thus, towns and cities represent unique habitats characterised by considerable ecological variation. Biologically active areas, where existence of life is possible, are separated by areas that are extremely difficult to settle. Urban green spaces, diversified in terms of size, form and origin, are interspersed by a network of streets and buildings so that "living" environmental enclaves form an archipelago of inland islands, either isolated or connected by means of ecological corridors in the form of, for instance, rows of trees and narrow belts of lawns (TROJAN & WINIARSKA 2001).

The centre is the most difficult to settle. It is a densely populated area with dense housing and considerable pollution, where green spaces are almost entirely man-made, forming small islands separated by concrete and asphalt. Urban green areas are rows of trees and bushes along streets and small lawns between buildings planted with species that have often come from geographical regions.

This habitat, subjected to particularly heavy settlement pressure, has been, for more than 50 years, the area of systematic studies of the species composition of noctuid communities (*Noctuidae*), one of the largest families of moths. The research was commenced by Adamczewski in 1948 and continued by him until 1984. However, Adamczewski only published data collected during the first few years of investigation (ADAMCZEWSKI 1951, 1964, 1966). Data have also been obtained during work carried out in the same area since 1976 by Winiarska as part of a larger project of zoocoenological research of the entomofauna of urban green spaces (CZECHOWSKI & PISARSKI 1981, 1986, 1987, CZECHOWSKI, GARBARCZYK, PISARSKI & SAWONIEWICZ 1982a,b, WINIARSKA 1982, 1986, 2001a) and also during a separate series of samples taken in the years 1976–1978. These studies were continued in 1999–2002 (WINIARSKA 2001b).

The present paper is based on the data collected in 1999–2002 by Winiarska, previously unpublished materials collected by Adamczewski in the years 1963–1984 and by Winiarska in the years 1976–1978 and 1998–2002 in the centre of Warsaw and data from literature. The goal is to describe noctuid communities from areas subjected to strong settlement pressure, in the centre of a large agglomeration (Warsaw) and to identify patterns of change in these communities over the last 50 years. It is another of a series of papers aiming to present the species composition of communities of *Lepidoptera* occurring in urban habitats (WINIARSKA 2002, WINIARSKA – in press). Together, these publications will form a basis for a comprehensive monograph presenting the process of colonization of urban habitats by *Lepidoptera* and changes that occur in communities of these insects under the influence of increasing settlement pressure as the city develops.

## STUDY AREA, MATERIALS AND METHODS

The study area, bounded by Marszałkowska St., Wilcza St., Emilii Plater St. and Aleje Jerozolimskie St., occupied an area of 0.5 km<sup>2</sup> in the most heavily built-up part of the Warsaw city centre. It is characterised by dense housing of old buildings with small yards that have miniature lawns with solitary trees. There is a number of brightly-lit shop displays and billboards.

The materials were collected using various methods – light traps and Moericke traps (in 3 yards) as well as stalking the moths along designated routes and on shop display window panes and similar sites. The materials were collected over three full seasons, from March to October each year. A total of about 300 specimens of noctuid moths were collected.

Comparative materials for analysis of long-term changes in noctuid communities over several years were derived from two sources:

– materials collected and partly described in published papers by Adamczewski, who used the same area for his studies in the years 1948–1984. In 1961–1984 he captured his specimens by stalking (chiefly from illuminated shop displays) and into light traps. In 1948 using a light trap hung on the top floor of the Institute of Zoology building he collected materials for his publication „Łuskoskrzydłe śródmieścia Warszawy (*Lepidoptera*)”, the first ever paper on Lepidoptera in the centre of Warsaw (ADAMCZEWSKI 1951). Another light trap was placed there in 1962–1963. In 1963–1966 Adamczewski studied Lepidoptera migrating over the city, catching his specimens with the light trap placed on the 38<sup>th</sup> floor of the Palace of Culture and Science.

– materials collected and partly described in published papers by Winiarska, who used for this purpose a light trap on the 5<sup>th</sup> floor of the Institute of Zoology building in 1976–1978, and later, in 1975–1979 collected materials for a zoocoenological study project that included also the centre of Warsaw.

As the present paper analyses materials collected over more than 50 years (data on a total of approximately 7,000 specimens from period 1948–2002) using a number of not easily comparable methods and the fieldwork was not aimed at determining the absolute abundance of individual species, which would be difficult in view of the variety of collection methods used, the relative abundance of individual species was estimated on the basis of the total number of individuals captured. Five number categories of abundance were distinguished: single, few, not abundant, abundant and very abundant.

Chronological arrangement of the data was ensured by dividing them into several periods: 1948 data, data obtained in 1961–1984 (arranged in 10-year spans) and materials from the period 1999–2002. This division does not form a basis for analysing changes in the species composition of noctuid communities in the centre of Warsaw, as individual categories differ in the length of the period of catches. A change-oriented analysis was carried out by comparing species composition in selected years (at 4-year intervals).

The material was collected in Warsaw in various types of urban habitats (city centre, housing estates, parks, suburban areas) over the last 100 years (the earliest report on the species composition of *Lepidoptera* in Warsaw dates back to 1911 – SLASTSHEVSKY 1911). The large number of species reported from the suburbs and city

centre is due to the fact that these areas were thoroughly studied over many years. In green spaces (on housing estates and parks) fieldwork was carried out for a shorter time and not all methods were employed. Data from this table were not used for comparison of species composition in various urban habitats, but indicated the sites where individual species were found.

A faunistic computer database on "Noctuidae in the urban environment of Warsaw" was compiled, consisting of taxonomical data (with a large list of synonymous names and original genera), data regarding the period of occurrence of individual species (historical data up to 1960 and contemporary data 1960–2002), their distribution in the city area (suburbs, green areas, centre) and a long list of relevant references. The database will be extended by adding data on all species of butterflies and moths found in Warsaw and other Polish towns and cities.

The names and systematic arrangement of taxa at family level in Table I and III are based on the check list of European *Lepidoptera* (KARSHOLT & RAZOWSKI 1996) with some modifications based on the list of Danish *Lepidoptera* (KARSHOLT & NIELSEN 1998), after BUSZKO & NOWACKI 2000. Two periods are distinguished (as in BUSZKO & NOWACKI 2000): early 19<sup>th</sup> century – 1960 (historical records) and from 1960 (contemporary records). Data on the abundance of individual species, their biology and distribution in Europe have been excerpted from FIBIGER 1990, 1993, 1997, NOWACKI 1998 and RONKAY G&L 1994, 1995, RONKAY, YELA & HREMBLAY 2001.

#### SPECIES COMPOSITION

In the centre of Warsaw 209 species of noctuid moths (*Noctuidae*, *Pantheidae* and *Nolidae*) were found (Table I), accounting for approximately 41% of all species from these families occurring in Poland (BUSZKO & NOWACKI 2002) and about 69% of noctuid species reported from the entire Warsaw agglomeration (WINIARSKA 2002).

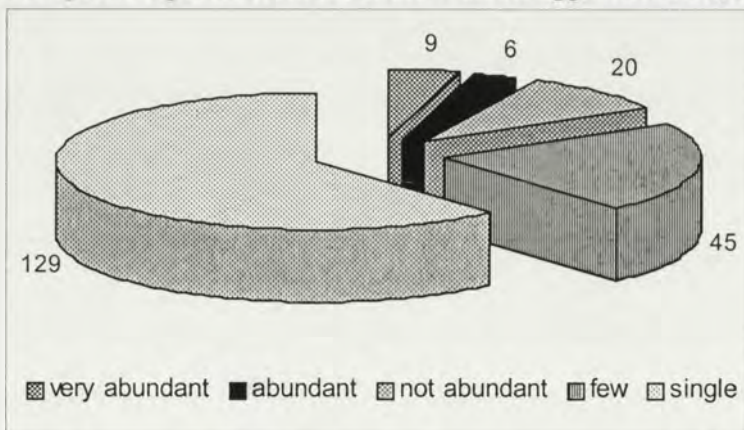


Figure. Percentage contribution in number of species of various categories in the noctuid communities in the centre of Warsaw.

The community under study was considerably diversified with respect to both species composition and abundance. As many as 174 species (73.2%) were classified as few and single while only 15 (7.2%) were very abundant and abundant in the habitat under study (Figure).

Table I. Check list of *Noctuidae*, *Pantheidae* and *Nolidae* occurring in Warsaw center; date obtained in study period 1961-1970 consists material: A - collected by different methods in different places, B - collected only by light trap placed on the 38<sup>th</sup> floor of the Palace of Culture and Science; VR - single, RE - few, NA - not abundant, AB - abundant, VAB - very abundant.

No	Species	Study periods						Occurrence
		1948	1961-1970		1971-1980	1981-1984	1999-2002	
			A	B				
1	2	3	4	5	6	7	8	9
<b>Noctuidae</b>								
<i>Acronictinae</i>								
1	<i>Acronicta psi</i> (L.)	+	+		+	+	+	NA
2	<i>Acronicta aceris</i> (L.)	+	+	+	+	+	+	NA
3	<i>Acronicta leporina</i> (L.)		+		+			VR
4	<i>Acronicta megecephala</i> (DEN.ET SCHIFF.)	+	+		+			VR
5	<i>Acronicta rumicis</i> (L.)	+	+		+	+		RE
6	<i>Simyra albovenosa</i> (GOEZE)		+					VR
<i>Bryophilinae</i>								
7	<i>Cryphia algae</i> (F.)	+						VR
<i>Herminiinae</i>								
8	<i>Trisateles emortualis</i> (DEN.ET SCHIFF.)				+			VR
9	<i>Herminia tarsicrinalis</i> (KNOCH)		+			+		VR
10	<i>Pechipogo strigilata</i> (L.)				+			VR
11	<i>Zanclognatha tarsipennalis</i> TREIT.		+		+			VR
<i>Strepsimaninae</i>								
12	<i>Hypenodes humidalis</i> DOUBL.		+		+			RE
<i>Catocalinae</i>								
13	<i>Catocala fraxini</i> (L.)		+		+			VR
14	<i>Catocala nupta</i> (L.)		+		+	+	+	NA
15	<i>Catocala elocata</i> (ESP.)	+	+		+	+	+	NA
16	<i>Lygephila pastinum</i> (TREIT.)				+			VR
17	<i>Catephia alchymista</i> (DEN.ET SCHIFF.)				+			VR
18	<i>Tyta luctuosa</i> (DEN.ET SCHIFF.)		+		+			VR
19	<i>Laspeyria flexula</i> (DEN.ET SCHIFF.)		+		+			VR
<i>Calpinae</i>								
20	<i>Scoliopteryx libatrix</i> (L.)		+		+	+	+	NA
<i>Hypeninae</i>								
21	<i>Hypena proboscidalis</i> (L.)		+		+	+		RE
22	<i>Hypena rostralis</i> (L.)		+		+			VR
23	<i>Rivula sericealis</i> (SCOP.)	+	+		+	+	+	AB
24	<i>Parascotia fuliginaria</i> (L.)				+			VR
<i>Plusiinae</i>								
25	<i>Diachrysis chrysitis</i> (L.)	+	+		+	+	+	NA
26	<i>Macdunnoughia confusa</i> (STEPH.)	+	+	+	+	+	+	VAB
27	<i>Plusia festucae</i> (L.)		+		+	+		RE
28	<i>Autographa gamma</i> (L.)	+	+	+	+	+	+	VAB
29	<i>Autographa bractea</i> (DEN. ET SCHIFF.)				+			VR
30	<i>Abrostola triplasia</i> (L.)	+	+		+	+		RE
<i>Acontiinae</i>								
31	<i>Emmelia trabealis</i> (SCOP.)	+	+		+			RE
32	<i>Acontia lucida</i> (HUFN.)	+	+					VR

1	2	3	4	5	6	7	8	9
<b>Eustrotiinae</b>								
33	<i>Protodeltote pygarga</i> (HUFN.)		+		+	+		RE
34	<i>Deltote uncula</i> (Cl.)		+		+	+		RE
35	<i>Deltote bankiana</i> (FABR.)		+		+			VR
36	<i>Pseudeustrotia candidula</i> (DEN.ET SCHIFF.)	+			+			VR
<b>Cucullinae</b>								
37	<i>Cucullia fraudatrix</i> EV.	+	+					VR
38	<i>Cucullia argentea</i> (HUFN.)				+			VR
39	<i>Cucullia artemisiae</i> (Hufn.)	+	+					VR
40	<i>Cucullia umbratica</i> (L.)		+	+	+	+		RE
41	<i>Cucullia chamomillae</i> (DEN.ET SCHIFF.)		+					VR
42	<i>Cucullia tanacetii</i> (DEN.ET SCHIFF.)		+					VR
43	<i>Calophasia lunula</i> (HUFN)		+					VR
<b>Amphipyriinae</b>								
44	<i>Amphipyra pyramidea</i> (L.)		+	+	+	+		VR
45	<i>Amphipyra livida</i> (DEN.ET.SCHIFF.)	+	+		+			VR
46	<i>Amphipyra tragopoginis</i> (CL.)	+	+	+	+	+	+	NA
<b>Dilobinae</b>								
47	<i>Diloba caeruleocephala</i> (L.)		+		+			VR
<b>Heliothinae</b>								
48	<i>Schinia scutosa</i> (DEN.ET SCHIFF.)	+	+		+			VR
49	<i>Heliothis viriplaca</i> (HUFN.)		+		+	+		RE
50	<i>Heliothis peltigera</i> (DEN.ET SCHIFF.)		+		+			VR
51	<i>Pyrrhia umbra</i> (HUFN.)	+	+		+			VR
<b>Hadeninae</b>								
52	<i>Elaphria venustula</i> (HBN.)				+	+		VR
53	<i>Caradrina morpheus</i> (HUFN.)	+	+	+	+	+	+	NA
54	<i>Paradrina selini</i> (BSD.)		+	+	+			VR
55	<i>Paradrina clavipalpis</i> (SCOP.)	+	+	+	+	+	+	AB
56	<i>Hoplodrina octogenaria</i> (GOEZE)	+	+		+	+		RE
57	<i>Hoplodrina blanda</i> (DEN.ET SCHIFF.)		+		+			VR
58	<i>Hoplodrina respersa</i> (DEN. ET SCHIFF.)	+	+					VR
59	<i>Hoplodrina ambigua</i> (DEN.ET SCHIFF.)	+	+		+	+	+	VAB
60	<i>Spodoptera exigua</i> (HBN.)				+			RE
61	<i>Chilodes maritima</i> (TAUSCH.)		+		+			VR
62	<i>Athetis pallustris</i> (HBN.)		+		+			VR
63	<i>Dypterygia scabriuscula</i> (L.)		+		+	+		VR
64	<i>Rusina ferruginea</i> (ESP.)		+		+			VR
65	<i>Thalpophila matura</i> (HUFN.)		+	+	+			VR
66	<i>Trachea atriplicis</i> (L.)	+	+		+	+		RE
67	<i>Euplexia lucipara</i> (L.)	+	+		+	+		VR
68	<i>Phlogophora meticulosa</i> (L.)		+		+	+		RE
69	<i>Hyppa rectilinea</i> (ESP.)				+			VR
70	<i>Ipimorpha subtusa</i> (DEN.ET SCHIFF.)	+	+		+			VR
71	<i>Enargia paleacea</i> (ESP.)				+			VR
72	<i>Parastichtis suspecta</i> (HBN.)		+		+			VR
73	<i>Parastichtis ypsillon</i> (DEN.ET SCHIFF.)	+	+		+			RE
74	<i>Mesogona oxalina</i> (HBN.)		+		+	+		VR

1	2	3	4	5	6	7	8	9
75	<i>Cosmia pyralina</i> (DEN.ET SCHIFF.)		+					VR
76	<i>Cosmia trapezina</i> (L.)	+	+	+	+	+	+	NA
77	<i>Xanthia togata</i> (ESP.)		+		+	+		RE
78	<i>Xanthia icteritia</i> (HUFN.)		+		+	+		NA
79	<i>Xanthia gilvago</i> (DEN.ET SCHIFF.)		+		+	+		RE
80	<i>Xanthia ocellaris</i> (BKH.)		+		+	+		RE
81	<i>Xanthia citrigo</i> (L.)				+			VR
82	<i>Agrochola lychnidis</i> (DEN.ET SCHIFF.)				+			VR
83	<i>Agrochola circellaris</i> (HUFN.)		+	+	+	+	+	NA
84	<i>Agrochola lota</i> (CL.)		+		+	+		RE
85	<i>Agrochola macilenta</i> (HBN.)		+					VR
86	<i>Agrochola litura</i> (L.)				+	+		RE
87	<i>Eupsilia transversa</i> (HUFN.)		+	+	+	+	+	NA
88	<i>Conistra vaccinii</i> (L.)		+		+			RE
89	<i>Conistra ligula</i> (ESP.)				+			VR
90	<i>Conistra rubiginosa</i> (SCOP.)		+		+	+		RE
91	<i>Conistra erythrocephala</i> (DEN.ET SCHIFF.)					+		VR
92	<i>Lithophane socia</i> (HUFN.)		+		+			VR
93	<i>Lithophane ornitopus</i> (HUFN.)		+					VR
94	<i>Lithophane furcifera</i> (HUFN.)		+	+	+			RE
95	<i>Xylena vetusta</i> (HBN.)		+	+	+	+		RE
96	<i>Xylena exoleta</i> (L.)		+		+			RE
97	<i>Blepharita saturo</i> (DEN.ET SCHIFF.)				+			VR
98	<i>Apamea monoglypha</i> (HUFN.)	+	+	+	+	+	+	RE
99	<i>Apamea lithoxyla</i> (DEN.ET SCHIFF.)	+	+		+			VR
100	<i>Apamea crenata</i> (HUFN.)		+		+	+		VR
101	<i>Apamea lateritia</i> (HUFN.)	+	+	+	+			VR
102	<i>Apamea furva</i> (DEN.ET SCHIFF.)		+		+			VR
103	<i>Apamea oblonga</i> (HAW.)				+			VR
104	<i>Apamea remissa</i> (HBN.)		+		+			VR
105	<i>Apamea anceps</i> (DEN.ET SCHIFF.)		+		+			VR
106	<i>Apamea sordens</i> (HUFN.)	+	+		+	+		RE
107	<i>Apamea ophiogramma</i> (ESP.)		+					VR
108	<i>Eremobina pabulatricula</i> (BRAHM)				+			VR
109	<i>Oligia strigilis</i> (L.)	+	+		+	+		RE
110	<i>Oligia latruncula</i> (DEN.ET SCHIFF.)		+		+	+	+	NA
111	<i>Oligia fasciuncula</i> (HAW.)					+		VR
112	<i>Mesoligia furuncula</i> (DEN.ET SCHIFF.)	+	+		+	+		RE
113	<i>Mesapamea secalis</i> (L.)	+	+	+	+	+		RE
114	<i>Luperina testacea</i> (DEN.ET SCHIFF.)	+	+		+	+	+	VAB
115	<i>Luperina zollikoferi</i> (FR.)		+					VR
116	<i>Rhizedra lutoso</i> (HBN.)		+		+	+		RE
117	<i>Amphipoea oculosa</i> (L.)		+					VR
118	<i>Amphipoea fucosa</i> (FR.)	+	+		+	+		RE
119	<i>Amphipoea lucens</i> (FR.)		+					VR
120	<i>Hydraecia micacea</i> (ESP.)		+		+			VR
121	<i>Gortyna flavago</i> (DEN.ET SCHIFF.)		+					VR

1	2	3	4	5	6	7	8	9
122	<i>Calamia tridens</i> (HUFN.)		+		+	+		VR
123	<i>Celaena haworthii</i> (CURT.)				+			VR
124	<i>Celaena leucostigma</i> (HBN.)	+	+		+	+		VR
125	<i>Nonagria typhae</i> (THNBG.)		+		+	+		RE
126	<i>Archanara sparganii</i> (ESP.)				+			VR
127	<i>Archanara algae</i> (ESP.)		+					VR
128	<i>Sedina buettneri</i> (HERING)		+		+	+		RE
129	<i>Chortodes fluxa</i> (HBN.)				+			VR
130	<i>Chortodes pygmina</i> (HAW.)				+			VR
131	<i>Discestra trifolii</i> (HUFN.)	+	+	+	+	+	+	VAB
132	<i>Lacanobia w-latinum</i> (HUFN.)		+					VR
133	<i>Lacanobia oleracea</i> (L.)	+	+	+	+	+		NA
134	<i>Lacanobia thalassina</i> (HUFN.)		+		+	+		RE
135	<i>Lacanobia suasa</i> (DEN.ET SCHIFF.)	+	+	+	+	+	+	AB
136	<i>Hada plebeja</i> (L.)				+			VR
137	<i>Hecatera dysodea</i> (DEN.ET SCHIFF.)	+	+		+			VR
138	<i>Hecatera bicolorata</i> (HUFN.)		+		+	+		VR
139	<i>Hadena bicruris</i> (HUFN.)		+	+	+			VR
140	<i>Hadena compta</i> (DEN.ET SCHIFF.)	+						VR
141	<i>Hadena confusa</i> (HUFN.)				+			VR
142	<i>Hadena rivularis</i> (FR.)		+		+			VR
143	<i>Hadena perplexa</i> (DEN.ET SCHIFF.)				+			VR
144	<i>Sideridis albicolon</i> (HBN.)	+	+		+			VR
145	<i>Heliophobus reticulata</i> (GOEZE)	+	+					VR
146	<i>Melanchra persicariae</i> (L.)	+	+		+	+		NA
147	<i>Melanchra pisi</i> (L.)				+			VR
148	<i>Mamestra brassicae</i> (L.)	+	+	+	+	+	+	NA
149	<i>Polia nebulosa</i> (HUFN.)		+		+	+		VR
150	<i>Mythimna conigera</i> (DEN.ET SCHIFF.)	+	+					VR
151	<i>Mythimna ferrago</i> (F.)		+		+	+		VR
152	<i>Mythimna albipuncta</i> (DEN.ET SCHIFF.)	+	+		+			RE
153	<i>Mythimna pudorina</i> (DEN.ET SCHIFF.)		+		+			VR
154	<i>Mythimna straminea</i> (TREIT.)					+		VR
155	<i>Mythimna impura</i> (HBN.)		+		+			VR
156	<i>Mythimna pallens</i> (L.)	+	+	+	+	+	+	VAB
157	<i>Mythimna obsoleta</i> (HBN.)	+	+		+	+		VR
158	<i>Mythimna comma</i> (L.)	+	+		+			VR
159	<i>Mythimna l-album</i> (L.)	+	+		+	+	+	AB
160	<i>Orthosia incerta</i> (HUFN.)		+		+	+		NA
161	<i>Orthosia gothica</i> (L.)		+		+	+		VR
162	<i>Orthosia cruda</i> (DEN.ET SCHIFF.)		+		+	+		RE
163	<i>Orthosia miniosa</i> (DEN.ET SCHIFF.)		+		+	+		VR
164	<i>Orthosia populeti</i> (F.)		+		+	+		NA
166	<i>Orthosia cerasi</i> (F.)		+		+	+		RE
166	<i>Orthosia gracilis</i> (DEN.ET SCHIFF.)		+		+	+		RE
167	<i>Orthosia munda</i> (DEN.ET SCHIFF.)		+		+	+		RE
168	<i>Panolis flammea</i> (DEN.ET SCHIFF.)		+					VR



1	2	3	4	5	6	7	8	9
169	<i>Egira conspicillaris</i> (L.)		+					VR
170	<i>Cerapteryx graminis</i> (L.)		+			+		VR
171	<i>Tholera caespitis</i> (DEN.ET SCHIFF.)		+		+			RE
172	<i>Tholera decimalis</i> (PODA)		+		+	+		RE
<b>Noctuidae</b>								
173	<i>Axylia putris</i> (L.)	+	+		+	+	+	RE
174	<i>Ochroleura plecta</i> (L.)		+		+	+		NA
175	<i>Diarsia brunnea</i> (DEN.ET SCHIFF.)				+			VR
176	<i>Diarsia rubi</i> (VIEW.)		+		+	+		RE
177	<i>Noctua pronuba</i> L.	+	+	+	+	+	+	AB
178	<i>Noctua orbona</i> (HUFN.)		+		+			VR
179	<i>Noctua fimbriata</i> (SCHREB.)		+	+	+			RE
180	<i>Noctua janthina</i> (DEN.ET SCHIFF.)		+	+				VR
181	<i>Lycophotia porphyrea</i> (DEN.ET SCHIFF.)					+		VR
182	<i>Rhyacia simulans</i> (HUFN.)	+		+	+	+		VR
183	<i>Eurois occulta</i> (L.)		+					VR
184	<i>Spaelotis ravida</i> (DEN.ET SCHIFF.)	+	+	+	+			VR
185	<i>Opigena polygona</i> (DEN.ET SCHIFF.)		+		+	+		VR
186	<i>Graphiphora augur</i> (F.)				+	+		VR
187	<i>Xestia c-nigrum</i> (L.)	+	+	+	+	+	+	VAB
188	<i>Xestia ditrapezium</i> (DEN.ET SCHIFF.)	+			+			VR
189	<i>Xestia triangulum</i> (HUFN.)		+		+			VR
190	<i>Xestia baja</i> (DEN.ET SCHIFF.)		+		+			VR
191	<i>Xestia xanthographa</i> (DEN.ET SCHIFF.)	+			+	+	+	NA
192	<i>Cerastis rubricosa</i> (DEN.ET SCHIFF.)					+		VR
193	<i>Naenia typica</i> (L.)				+	+		VR
194	<i>Anaplectoides prasina</i> (DEN.ET SCHIFF.)			+	+			VR
195	<i>Actebia praecox</i> (L.)	+			+			VR
196	<i>Euxoa nigricans</i> (L.)		+		+			VR
197	<i>Euxoa tritici</i> (L.)	+	+		+	+		VR
198	<i>Euxoa obelisca</i> (DEN.ET SCHIFF.)		+		+			VR
199	<i>Agrotis ipsilon</i> (HUFN.)	+	+	+	+	+	+	AB
200	<i>Agrotis exclamationis</i> (HBN.)	+	+	+	+	+	+	VAB
201	<i>Agrotis clavis</i> (HUFN.)		+		+	+		VR
202	<i>Agrotis segetum</i> (DEN.ET SCHIFF.)	+	+	+	+	+	+	VAB
203	<i>Agrotis vestigialis</i> (HUFN.)		+		+			VR
<b>Pantheidae</b>								
204	<i>Colocasia coryli</i> (L.)					+		VR
<b>Noctuidae</b>								
<b>Chloephorinae</b>								
205	<i>Nycteola revayana</i> (SCOP.)					+		VR
206	<i>Bena bicolorana</i> (FUESSLY)					+		VR
207	<i>Pseudoips prasinana</i> (L.)		+		+			VR
208	<i>Earias clorana</i> (L.)		+					VR
209	<i>Earias vernana</i> (F.)		+		+			VR

Species classified as very abundant were recorded during every year of the study period (1948–2002). This group was composed of species occurring abundantly all over Poland (Table II, Figure). These species are associated with open-area sites (including anthropogenic habitats) and their larvae usually feed on common herbaceous plants. Some, such as *Autographa gamma*, *Agrotis exclamationis* or *A. segetum* become pests to crops when they appear in large numbers.

Table II. Noctuid species occurring in greatest numbers in the centre of Warsaw (starting from the most abundant species); OAA – open areas, also anthropogenic ones, DAA – different areas, also anthropogenic ones, WA – whole area.

No.	Species	Habitat preference	Distribution in Poland	Notes
1.	<i>Xestia c-nigrum</i> (L.)	OAA	WA	
2.	<i>Autographa gamma</i> (L.)	OAA	WA	migratory species
3.	<i>Discestra trifolii</i> (HUFN.)	DAA	WA	
4.	<i>Mythimna pallens</i> (L.)	OAA	WA	
5.	<i>Agrotis exclamationis</i> (HBN.)	OAA	WA	
6.	<i>Agrotis segetum</i> (DEN.ET SCHIFF.)	OAA	WA	
7.	<i>Mythimna l-album</i> (L.)	DAA	WA	migratory species
8.	<i>Hoplodrina ambigua</i> (DEN.ET SCHIFF.)	OAA	WA	
9.	<i>Luperina testacea</i> (DEN.ET SCHIFF.)	OAA	WA	

This group also includes migratory species, flying into Poland from the south of Europe every year (*A. gamma* and *M. l-album*).

By far the most abundant species was *Xestia c-nigrum*, widely distributed in the northern hemisphere and associated with non-forest habitats. Its larvae are polyphagous and feed on herbaceous plants.

The group of very abundant species includes also *A. gamma*, *Discestra trifolii* and *Mythimna pallens*. *A. gamma* is a Euro-Asian species abundant throughout Europe and reported from many habitats, including anthropogenic ones. The larvae are polyphagous. *D. trifolii* is a eurytopic species that also occurs in anthropogenic habitats. The larvae feed on herbaceous plants. *M. pallens* is associated with various open-area habitats, the larvae feeding on grasses.

Species classified as abundant were also recorded during every year of the study and, like very abundant species, they also occur abundantly all over Poland. This group also includes migratory species, such as *Macdunnoughia confusa* and *Agrotis ipsilon*. *M. confusa* is a Euro-Asian species recorded all over Europe and abundant. It is mainly found in open-area habitats and its larvae feed on various plants. *A. ipsilon* is a eurytopic species, occurring abundantly across the whole of Central Europe. It is known mainly from open-area habitats, including anthropogenic ones. The larvae feed on herbaceous plants.

Nearly all of the species classified as very abundant in the city centre were also found in other types of urban green areas, chiefly parks. Some of them, such as *A. gamma* or *D. trifolii*, were very abundant there. *X. c-nigrum*, *A. gamma*, *M. pallens* and *M. l-album* were classified as constant components in this type of urban green area (WINIARSKA 1986) (Table III).

Table III. Check list of *Noctuidae*, *Pantheidae* and *Nolidae* occurring in the different habitats of Warsaw.

No	Species	Warsaw			
		suburbs	urban green areas		
			parks	housing	town
1	2	3	4	5	6
<b>Noctuidae</b>					
<b>Acronictinae</b>					
1	<i>Moma alpium</i> (OSB.)	+			
2	<i>Acronicta cuspis</i> (HBN.)	+			
3	<i>Acronicta tridens</i> (DEN.ET SCHIFF.)	+			
4	<i>Acronicta psi</i> (L.)	+	+	+	+
5	<i>Acronicta aceris</i> (L.)	+	+		+
6	<i>Acronicta leporina</i> (L.)	+	+		+
7	<i>Acronicta megacephala</i> (DEN.ET SCHIFF.)	+	+		+
8	<i>Acronicta strigosa</i> (DEN.ET SCHIFF.)	+			
9	<i>Acronicta menyanthidis</i> (ESP.)	+			
10	<i>Acronicta auricoma</i> (DEN.ET SCHIFF.)	+			
11	<i>Acronicta euphorbiae</i> (DEN.ET SCHIFF.)	+			
12	<i>Acronicta rumicis</i> (L.)	+			+
13	<i>Craniophora ligustri</i> (DEN.ET SCHIFF.)	+			
14	<i>Simyra nervosa</i> (DEN.ET SCHIFF.)	+			
15	<i>Simyra albovenosa</i> (GOEZE)	+			+
<b>Bryophilinae</b>					
16	<i>Cryphia fraudatricula</i> (HBN.)	+			
17	<i>Cryphia algae</i> (F.)	+			+
<b>Hermiiniinae</b>					
18	<i>Idia calvaria</i> (DEN.ET SCHIFF.)	+			
19	<i>Trisateles emortualis</i> (DEN.ET SCHIFF.)	+			+
20	<i>Paracolax tristalis</i> (F.)	+			
21	<i>Herminia tarsicrinalis</i> (KNOCH)	+			+
22	<i>Herminia griscalis</i> (DEN.ET SCHIFF.)	+			
23	<i>Polypogon tentacularia</i> (L.)	+			
24	<i>Pechipogo strigilata</i> (L.)	+			+
25	<i>Zanclognatha lunalis</i> (SCOP.)	+			
26	<i>Zanclognatha tarsipennalis</i> TREIT.	+			+
<b>Strepsimaninae</b>					
27	<i>Hypenodes humidalis</i> DOUBL.				+
28	<i>Schrankia costaestrigalis</i> (STEPH.)	+			
29	<i>Schrankia taenialis</i> (HBN.)	+			
<b>Catocalinae</b>					
30	<i>Catocala fraxini</i> (L.)	+			+
31	<i>Catocala sponsa</i> (L.)	+			
32	<i>Catocala nupta</i> (L.)	+	+		+
33	<i>Catocala elocata</i> (ESP.)	+		+	+
34	<i>Catocala promissa</i> (DEN.ET SCHIFF.)	+			
35	<i>Catocala pacta</i> (L.)	+			
36	<i>Catocala fulminea</i> (SCOP.)	+		+	

1	2	3	4	5	6
37	<i>Minucia lunaris</i> (DEN.ET SCHIFF.)	+			
38	<i>Lygephila pastinum</i> (TREIT.)	+			+
39	<i>Lygephila craccae</i> (DEN.ET SCHIFF.)	+			
40	<i>Catephia alchymista</i> (DEN.ET SCHIFF.)	+			+
41	<i>Tyta luctuosa</i> (DEN.ET SCHIFF.)	+			+
42	<i>Callistege mi</i> (CL.)	+			
43	<i>Euclidia glyphica</i> (L.)	+			
44	<i>Laspeyria flexula</i> (DEN.ET SCHIFF.)	+			+
<b>Calpinae</b>					
45	<i>Scoliopteryx libatrix</i> (L.)	+	+	+	+
<b>Hypeninae</b>					
46	<i>Hypena proboscidalis</i> (L.)	+	+		+
47	<i>Hypena rostralis</i> (L.)	+			+
48	<i>Hypena crassalis</i> (F.)	+			
49	<i>Rivula sericealis</i> (SCOP.)	+			+
50	<i>Parascotia fuliginaria</i> (L.)	+			+
51	<i>Colobochyla salicalis</i> (DEN.ET SCHIFF.)	+			
<b>Plusiinae</b>					
52	<i>Polychrysis moneta</i> (F.)	+			
53	<i>Lamprotes c-aureum</i> (KNOCH)	+			
54	<i>Diachrysis chrysitis</i> (L.)	+	+		+
55	<i>Macdunnoughia confusa</i> (STEPH.)	+	+		+
56	<i>Plusia festucae</i> (L.)	+			+
57	<i>Autographa gamma</i> (L.)	+	+	+	+
58	<i>Autographa pulchrina</i> (HAW.)	+			
59	<i>Autographa bractea</i> (DEN. ET SCHIFF.)				+
60	<i>Plusidia cheiranthi</i> (TAUSCH.)	+			
61	<i>Syngrapha interrogationis</i> (L.)	+			
62	<i>Abrostola tripartita</i> (HUFN.)	+			
63	<i>Abrostola triplasia</i> (L.)	+	+		+
<b>Acontiinae</b>					
64	<i>Enmelia trabealis</i> (SCOP.)	+	+		+
65	<i>Acontia lucida</i> (HUFN.)	+			+
<b>Eustrotiinae</b>					
66	<i>Protodeltote pygarga</i> (HUFN.)	+			+
67	<i>Deltote uncula</i> (CL.)	+			+
68	<i>Deltote bankiana</i> (FABR.)	+			+
69	<i>Pseudeustrotia candidula</i> (DEN.ET SCHIFF.)	+			+
70	<i>Eublemma minutata</i> (F.)	+			
<b>Cucullinae</b>					
71	<i>Cucullia fraudatrix</i> EV.	+			+
72	<i>Cucullia absinthii</i> (L.)	+			
73	<i>Cucullia argentea</i> (HUFN.)	+			+
74	<i>Cucullia artemisiae</i> (Hufn.)	+			+
75	<i>Cucullia umbratica</i> (L.)	+			+
76	<i>Cucullia chamomillae</i> (DEN.ET SCHIFF.)	+			+
77	<i>Cucullia tanaceti</i> (DEN.ET SCHIFF.)	+			+
78	<i>Cucullia asteris</i> (DEN.ET SCHIFF.)	+			

1	2	3	4	5	6
79	<i>Shargacucullia scrophulariae</i> (DEN.ET SCHIFF.)	+			
80	<i>Shargacucullia thapsiphaga</i> (TREIT.)	+			
81	<i>Shargacucullia lychnitis</i> (RAMB.)	+			
82	<i>Shargacucullia verbasci</i> (L.)	+			
83	<i>Calophasia lunula</i> (HUFN)	+			+
<b>Amphipyridinae</b>					
84	<i>Amphipyra pyramidea</i> (L.)	+	+		+
85	<i>Amphipyra livida</i> (DEN.ET.SCHIFF.)	+			+
86	<i>Amphipyra tragopoginis</i> (CL.)	+			+
<b>Psaphidinae</b>					
87	<i>Asteroscopus sphinx</i> (HUFN.)	+			
88	<i>Brachionycha nubeculosa</i> (ESP.)	+			
<b>Dilobinae</b>					
89	<i>Diloba caeruleocephala</i> (L.)	+			+
<b>Stiriinae</b>					
90	<i>Panemeria tenebrata</i> (SCOP.)	+			
<b>Heliothinae</b>					
91	<i>Schinia scutosa</i> (DEN.ET SCHIFF.)	+			+
92	<i>Heliothis virescens</i> (HUFN.)	+			+
93	<i>Heliothis ononis</i> (DEN.ET SCHIFF.)	+			
94	<i>Heliothis peltigera</i> (DEN.ET SCHIFF.)				+
95	<i>Pyrrhia umbra</i> (HUFN.)	+	+	+	+
<b>Hadeninae</b>					
96	<i>Elaphria venustula</i> (HBN.)	+			+
97	<i>Caradrina morpheus</i> (HUFN.)	+		+	+
98	<i>Paradrina selini</i> (BSD.)	+			+
99	<i>Paradrina clavipalpis</i> (SCOP.)	+			+
100	<i>Hoplodrina octogenaria</i> (GOEZE)	+			+
101	<i>Hoplodrina blanda</i> (DEN.ET SCHIFF.)	+	+		+
102	<i>Hoplodrina respersa</i> (DEN. ET SCHIFF.)				+
103	<i>Hoplodrina ambigua</i> (DEN.ET SCHIFF.)	+	+		+
104	<i>Charanyca trigrammica</i> (HUFN.)	+			
105	<i>Spodoptera exigua</i> (HBN.)				+
106	<i>Chilodes maritima</i> (TAUSCH.)	+			+
107	<i>Athetis pallustris</i> (HBN.)				+
108	<i>Dypterygia scabriuscula</i> (L.)	+	+		+
109	<i>Rusina ferruginea</i> (ESP.)	+			+
110	<i>Thalophila matura</i> (HUFN.)	+			+
111	<i>Trachea atriplicis</i> (L.)	+	+	+	+
112	<i>Euplexia lucipara</i> (L.)	+	+		+
113	<i>Phlogophora meticulosa</i> (L.)	+			+
114	<i>Hyppa rectilinea</i> (ESP.)	+			+
115	<i>Actinotia polyodon</i> (CL.)	+			
116	<i>Callopietria juvenina</i> (STOLL)	+			
117	<i>Ipimorpha retusa</i> (L.)	+			
118	<i>Ipimorpha subtusa</i> (DEN.ET SCHIFF.)				+
119	<i>Enargia paleacea</i> (ESP.)	+			+
120	<i>Parastichtis suspecta</i> (HBN.)	+			+

1	2	3	4	5	6
121	<i>Parastichtis ypsilon</i> (DEN.ET SCHIFF.)	+			+
122	<i>Mesogona acetosellae</i> (DEN.ET SCHIFF.)	+			
123	<i>Mesogona oxalina</i> (HBN.)	+			+
124	<i>Dicycla oo</i> (L.)	+			
125	<i>Cosmia affinis</i> (L.)	+			
126	<i>Cosmia pyralina</i> (DEN.ET SCHIFF.)	+			+
127	<i>Cosmia trapezina</i> (L.)	+	+	+	+
128	<i>Xanthia togata</i> (ESP.)	+			+
129	<i>Xanthia icteritia</i> (HUFN.)	+			+
130	<i>Xanthia gilvago</i> (DEN.ET SCHIFF.)	+	+		+
131	<i>Xanthia ocellaris</i> (BKH.)	+			+
132	<i>Xanthia citrigo</i> (L.)	+			+
133	<i>Agrochola lychmidis</i> (DEN.ET SCHIFF.)				+
134	<i>Agrochola circellaris</i> (HUFN.)	+	+		+
135	<i>Agrochola lota</i> (CL.)	+			+
136	<i>Agrochola macilenta</i> (HBN.)				+
137	<i>Agrochola helvola</i> (L.)	+			
138	<i>Agrochola litura</i> (L.)	+	+		+
139	<i>Eupsilia transversa</i> (HUFN.)	+	+		+
140	<i>Jodia croceago</i> (DEN.ET SCHIFF.)	+			
141	<i>Conistra vaccinii</i> (L.)	+			+
142	<i>Conistra ligula</i> (ESP.)	+			+
143	<i>Conistra rubiginosa</i> (SCOP.)	+			+
144	<i>Conistra rubiginea</i> (DEN.ET SCHIFF.)	+			
145	<i>Conistra erythrocephala</i> (DEN.ET SCHIFF.)	+			+
146	<i>Lithomoia solidaginis</i> (HBN.)	+			
147	<i>Lithophane socia</i> (HUFN.)	+			+
148	<i>Lithophane ornitopus</i> (HUFN.)	+			+
149	<i>Lithophane furcifera</i> (HUFN.)	+			+
150	<i>Lithophane lamda</i> (F.)	+			
151	<i>Xylena vetusta</i> (HBN.)	+			+
152	<i>Xylena exoleta</i> (L.)	+			+
153	<i>Allophytes oxyacanthae</i> (L.)	+			
154	<i>Dichonia aprilina</i> (L.)	+			
155	<i>Dryobotes eremita</i> (F.)	+			
156	<i>Antitype chi</i> (L.)	+			
157	<i>Ammoconia caecimacula</i> (DEN.ET SCHIFF.)	+			
158	<i>Blepharita satura</i> (DEN.ET SCHIFF.)	+			+
159	<i>Apamea monoglypha</i> (HUFN.)	+	+	+	+
160	<i>Apamea lithoxyla</i> (DEN.ET SCHIFF.)	+		+	+
161	<i>Apamea sublustris</i> (ESP.)	+			
162	<i>Apamea crenata</i> (HUFN.)	+			+
163	<i>Apamea lateritia</i> (HUFN.)	+			+
164	<i>Apamea furva</i> (DEN.ET SCHIFF.)	+			+
165	<i>Apamea oblonga</i> (HAW.)	+			+
166	<i>Apamea remissa</i> (HBN.)	+			+
167	<i>Apamea unanimitis</i> (HBN.)	+			

1	2	3	4	5	6
168	<i>Apamea anceps</i> (DEN.ET SCHIFF.)	+			+
169	<i>Apamea sordens</i> (HUFN.)	+			+
170	<i>Apamea scolopacina</i> (ESP.)	+			
171	<i>Apamea ophiogramma</i> (ESP.)	+			+
172	<i>Eremobina pabulatricula</i> (BRAHM)	+			+
173	<i>Oligia strigilis</i> (L.)	+		+	+
174	<i>Oligia latruncula</i> (DEN.ET SCHIFF.)	+			+
175	<i>Oligia fasciuncula</i> (HAW.)				+
176	<i>Mesoligia furuncula</i> (DEN.ET SCHIFF.)	+			+
177	<i>Mesapamea secalis</i> (L.)	+			+
178	<i>Luperina testacea</i> (DEN.ET SCHIFF.)	+			+
179	<i>Luperina zollikoferi</i> (FR.)				+
180	<i>Rhizedra lutosa</i> (HBN.)				+
181	<i>Amphipoea oculea</i> (L.)	+			+
182	<i>Amphipoea fucosa</i> (FR.)	+	+	+	+
183	<i>Amphipoea lucens</i> (FR.)				+
184	<i>Hydraecia micacea</i> (ESP.)	+			+
185	<i>Gortyna flavago</i> (DEN.ET SCHIFF.)	+			+
186	<i>Calamia tridens</i> (HUFN.)	+			+
187	<i>Celaena haworthii</i> (CURT.)				+
188	<i>Celaena leucostigma</i> (HBN.)	+	+		+
189	<i>Nonagra typhae</i> (THNBG.)	+			+
190	<i>Archanaera geminipuncta</i> (HAW.)	+	+		
191	<i>Archanaera sparganii</i> (ESP.)	+			+
192	<i>Archanaera algae</i> (ESP.)	+			+
193	<i>Sedina buettneri</i> (HERING)				+
194	<i>Chortodes fluxa</i> (HBN.)	+			+
195	<i>Chortodes pygmina</i> (HAW.)				+
196	<i>Discestra trifolii</i> (HUFN.)	+	+		+
197	<i>Anarta myrtilii</i> (L.)	+			
198	<i>Lacanobia w-latinum</i> (HUFN.)	+			+
199	<i>Lacanobia aliena</i> (HBN)	+			
200	<i>Lacanobia splendens</i> (HBN.)	+			
201	<i>Lacanobia oleracea</i> (L.)	+	+	+	+
202	<i>Lacanobia thalassina</i> (HUFN.)	+			+
203	<i>Lacanobia contigua</i> (DEN.ET SCHIFF.)	+			
204	<i>Lacanobia suasa</i> (DEN.ET SCHIFF.)	+	+		+
205	<i>Hada plebeja</i> (L.)	+			+
206	<i>Hecatera dysodea</i> (DEN.ET SCHIFF.)	+			+
207	<i>Hecatera bicolorata</i> (HUFN.)	+			+
208	<i>Hadena bicruris</i> (HUFN.)	+			+
209	<i>Hadena compta</i> (DEN.ET SCHIFF.)	+			+
210	<i>Hadena confusa</i> (HUFN.)				+
211	<i>Hadena albimacula</i> (BKH.)	+			
212	<i>Hadena rivularis</i> (FR.)	+			+
213	<i>Hadena perplexa</i> (DEN.ET SCHIFF.)	+			+
214	<i>Hadena irregularis</i> (HUFN.)	+			

1	2	3	4	5	6
215	<i>Sideridis albicolon</i> (HBN.)	+			+
216	<i>Heliophobus reticulata</i> (GOEZE)	+			+
217	<i>Melanchra persicariae</i> (L.)	+	+		+
218	<i>Melanchra pisi</i> (L.)	+			+
219	<i>Mamestra brassicae</i> (L.)	+	+	+	+
220	<i>Papestra biren</i> (GOEZE)	+			
221	<i>Polia bombycina</i> (HUFN.)	+			
222	<i>Polia hepatica</i> (Cl.)	+			
223	<i>Polia nebulosa</i> (HUFN.)	+			+
224	<i>Mythimna turca</i> (L.)	+			
225	<i>Mythimna conigera</i> (DEN.ET SCHIFF.)	+	+		+
226	<i>Mythimna ferrago</i> (F.)	+			+
227	<i>Mythimna albipuncta</i> (DEN.ET SCHIFF.)	+	+		+
228	<i>Mythimna pudorina</i> (DEN.ET SCHIFF.)	+			+
229	<i>Mythimna straminea</i> (TREIT.)				+
230	<i>Mythimna impura</i> (HBN.)	+			+
231	<i>Mythimna pallens</i> (L.)	+	+		+
232	<i>Mythimna obsoleta</i> (HBN.)	+			+
233	<i>Mythimna comma</i> (L.)	+			+
234	<i>Mythimna flammea</i> (CURT.)	+			
235	<i>Mythimna l-album</i> (L.)	+	+	+	+
236	<i>Orthosia incerta</i> (HUFN.)	+			+
237	<i>Orthosia gothica</i> (L.)	+			+
238	<i>Orthosia cruda</i> (DEN.ET SCHIFF.)	+			+
239	<i>Orthosia miniosa</i> (DEN.ET SCHIFF.)	+			+
240	<i>Orthosia opina</i> (HBN.)	+			
241	<i>Orthosia populeti</i> (F.)	+			+
242	<i>Orthosia cerasi</i> (F.)	+			+
243	<i>Orthosia gracilis</i> (DEN.ET SCHIFF.)	+			+
244	<i>Orthosia munda</i> (DEN.ET SCHIFF.)	+			+
245	<i>Panolis flammea</i> (DEN.ET SCHIFF.)	+			+
246	<i>Egira conspicularis</i> (L.)	+			+
247	<i>Cerapteryx graminis</i> (L.)	+			+
248	<i>Tholera caespitis</i> (DEN.ET SCHIFF.)	+			+
249	<i>Tholera decimalis</i> (PODA)	+			+
250	<i>Pachetra sagittigera</i> (HUFN.)	+			
<b>Noctuidae</b>					
251	<i>Axylia putris</i> (L.)	+	+		+
252	<i>Ochropleura plecta</i> (L.)	+			+
253	<i>Diarsia mendica</i> (F.)	+			
254	<i>Diarsia brunnea</i> (DEN.ET SCHIFF.)	+			+
255	<i>Diarsia rubi</i> (VIEW.)	+	+		+
256	<i>Noctua pronuba</i> L.	+	+	+	+
257	<i>Noctua orbona</i> (HUFN.)	+			+
258	<i>Noctua comes</i> HBN.	+			
259	<i>Noctua fimbriata</i> (SCHREB.)	+			+
260	<i>Noctua janthina</i> (DEN.ET SCHIFF.)	+			+



1	2	3	4	5	6
261	<i>Lycophotia porphyrea</i> (DEN.ET SCHIFF.)	+			+
262	<i>Rhyacia simulans</i> (HUFN.)	+			+
263	<i>Eurois occulta</i> (L.)	+			+
264	<i>Spaelotis ravida</i> (DEN.ET SCHIFF.)	+			+
265	<i>Opigena polygona</i> (DEN.ET SCHIFF.)	+			+
266	<i>Graphiphora augur</i> (F.)				+
267	<i>Xestia c-nigrum</i> (L.)	+	+		+
268	<i>Xestia ditrapezium</i> (DEN.ET SCHIFF.)	+			+
269	<i>Xestia triangulum</i> (HUFN.)	+			+
270	<i>Xestia ashworthii</i> (DOUBL.)	+			
271	<i>Xestia baja</i> (DEN.ET SCHIFF.)	+			+
272	<i>Xestia xanthographa</i> (DEN.ET SCHIFF.)	+			+
273	<i>Eugraphe sigma</i> (DEN.ET SCHIFF.)	+			
274	<i>Cerastis rubricosa</i> (DEN.ET SCHIFF.)	+			+
275	<i>Naenia typica</i> (L.)	+			+
276	<i>Anaplectoides prasina</i> (DEN.ET SCHIFF.)	+			+
277	<i>Peridroma saucia</i> (HBN.)	+			
278	<i>Actebia praecox</i> (L.)	+			+
279	<i>Euxoa nigricans</i> (L.)	+			+
280	<i>Euxoa tritici</i> (L.)	+			+
281	<i>Euxoa obelisca</i> (DEN.ET SCHIFF.)	+			+
282	<i>Euxoa cursoria</i> (HUFN.)	+			
283	<i>Yigoga signifera</i> (DEN.ET SCHIFF.)	+			
284	<i>Agrotis crassa</i> (HBN.)	+			
285	<i>Agrotis ipsilon</i> (HUFN.)	+			+
286	<i>Agrotis exclamationis</i> (HBN.)	+	+		+
287	<i>Agrotis clavis</i> (HUFN.)	+			+
288	<i>Agrotis segetum</i> (DEN.ET SCHIFF.)	+	+		+
289	<i>Agrotis vestigialis</i> (HUFN.)	+			+
290	<i>Agrotis cinerea</i> (DEN.ET SCHIFF.)	+			
<b>Pantheidae</b>					
291	<i>Panthea coenobita</i> (ESP.)	+			
292	<i>Colocasia coryli</i> (L.)	+			+
<b>Nolidae</b>					
<b>Nolinae</b>					
293	<i>Meganola togatulis</i> (HBN.)	+			
294	<i>Meganola albula</i> (DEN.ET SCHIFF.)	+			
295	<i>Nola cucullatella</i> (L.)	+			
296	<i>Nola confusalis</i> (H.-S.)	+			
<b>Chloephorinae</b>					
297	<i>Nycteola revayana</i> (SCOP.)	+			+
298	<i>Nycteola degenerana</i> (HBN.)	+			
299	<i>Bena bicolorana</i> (FUESSLY)	+			+
300	<i>Pseudoips prasinana</i> (L.)	+			+
301	<i>Earias clorana</i> (L.)	+			+
302	<i>Earias vernana</i> (F.)				+

Single and few species (usually represented by a small number of specimens in the multi-year sample) made up the bulk of the noctuid community in the centre of Warsaw (Figure). Most of these species can be found all over Poland. Species with more limited distributions included *Cucullia tanacetii*, *C. chamomillae*, *Schinia scutosa*, *Calophasia lunula*, *Conistra erythrocephala*, *Xylena exoleta* and *Eremobina pabulatricula*.

The most interesting species in this group were:

– *Amphipoea lucens*, *Hoplodrina respersa* and *Oligia fasciuncula*, which had never before been recorded in the Mazovian Lowland. *A. lucens* is a hygrophilous species inhabiting peatbogs and moist meadows. The larvae feed on *Eriophorum vagintum*. *H. respersa* inhabits dry open areas (steppe, limestone slopes), the larvae feeding on various herbaceous plants. *O. fasciuncula* is found in various types of open-area habitats (species shifting its range toward east). Its larvae feed on various species of grass. Adamczewski collected one individual of each of these species – *A. lucens* in 1969, *H. respersa* in 1962 and *O. fasciuncula* in 1984.

– *Catephia alchymista*, *Autographa bractea*, *Acontia lucida* and *Euxoa obelisca* were reported from the Mazovian Lowland only in historical records (BLSZKO & NOWACKI 2000). The Mediterranean *C. alchymista* is associated with warm oak forests, the larvae feeding on *Quercus spp.* At present it is only found in some regions of Poland, but it used to be more widely distributed in this country. *A. bractea* can be found throughout Central Europe and is sometimes quite abundant, especially in mountainous regions. It is associated with open-area habitats in forests, such as meadows and clearings. The larvae feed on herbaceous plants. It has been recorded all around Poland. *A. lucida* has been recently recorded only from the Carpathian foothills but this species was also more widely distributed in historical times (now it is probably extinct in Poland). This xerophilous species occurs in dry and warm open-area habitats. The larvae feed on *Althaea spp.*, *Convolvulus spp.*, *Taraxacum spp.* and others. *E. obelisca* occurs in all parts of Central Europe and is quite abundant at some locations. It is associated with grassy open-area habitats. Its larvae feed on herbaceous plants. It has been found in a number of regions in Poland. Adamczewski collected only single specimens of these species *A. lucida* in 1969, *C. alchymista* in 1977, *E. obelisca* in 1962 and 1976, and *A. bractea* in 1975.

For a number of species captured, the city centre is the only locality in the Warsaw agglomeration where they have been found to date (they have not been reported in any other habitat in Warsaw) (Table IV). They all are migrants in the city centre.

These species have various habitat preferences and are usually found only in some parts of Poland. In the centre of Warsaw they were sporadically recorded and classified as single or few species.

Thus, moths occurring in the centre of Warsaw can be divided into several groups based on the habitat preferences of individual species and their viability in an urbanised environment.

One group includes species which larvae can feed on plants found in the city, both herbaceous plants (chiefly grasses) and trees. Grasses serve as food for larvae of species classified as very abundant in the centre, such as *A. exclamationis*, as well as those found only sporadically in this part of the city: *Apamea monoglypha*, *Mythimna al-*

*bipuncta* or *Mesapamea secalis*. Herbaceous plants in ruderal areas are fed upon by caterpillars of *X. c-nigrum* (the most abundant species in the centre of Warsaw), *Lacanobia suasa*, *Caradrina morpheus*, *Diachrysis chrysitis* or *Melanchnra persicariae* (classified as not abundant in Warsaw city centre). *Acronicta psi*, *Cosmia trapezina* and *Catocala elocata* (not abundant in this habitat) feed on trees.

Table IV. Noctuid species recorded only in the centre of Warsaw.

No.	Species	Habitat preference	Distribution in Poland
1.	<i>Hyphenodes humidalis</i> DOUBL.	OWE	PP
2.	<i>Autographa bractea</i> (DEN. ET)	OFO	PP
3.	<i>Spodoptera exigua</i> (HBN.)	OAA	PP
4.	<i>Athetis pallustris</i> (HBN.)	OWE	PP
4.	<i>Ipimorpha subtusa</i> (DEN.ET)	LMF	WA
5.	<i>Agrochola macilenta</i> (HBN.)	LMF	WA
6.	<i>Rhizedra lutosa</i> (HBN.)	OWE	WA
7.	<i>Hadena confusa</i> (HUFN.)	ODR	PP
8.	<i>Mythimna straminea</i> (TREIT.)	OWE	PP
9.	<i>Earias vernana</i> (F.)	LFO	PP

Another group includes species associated with human habitations. A representative example is *Paradrina clavipalpis*, occurring abundantly in the centre of Warsaw. Its larvae may feed on flour products.

A third group comprises species flying into the city centre from adjacent habitats – waterlogged areas (*Mythimna comma*, *M. obsoleta*, *Ce-*

*laena leucostigma*), allotment gardens (*Mamestra brassicae*, *Lacanobia oleracea*) and parks (*Pyrrha umbra*, *Cosmia trapezina*, *A. pyramidea*).

Finally, a fourth group is made up of migratory species, such as *A. gamma*, *M. l-album*, *M. confusa* and *A. ipsilon* (classified as very abundant in the centre), which fly over the centre during their migrations.

#### CHANGES IN COMMUNITIES OF NOCTUID MOTHS INHABITING CENTRE OF WARSAW IN YEARS 1948–2002

In order to trace changes in noctuid communities inhabiting the centre of Warsaw over the last 50 years, we compared species composition data regarding these communities from the years 1961–1964, 1971–1974, 1981–1984 and 1999–2002 (Table V).

Table V. Number of species of various categories in the noctuid communities in the centre of Warsaw in years 1961–1964, 1971–1974, 1981–1984, 1999–2002.

Study period	Number of all recorded species	Number of species which are:		
		very abundant and abundant	not abundant	single nad few
total (1948-2002)	209	15	20	174
1961-1964	130	15	20	95
1971-1974	109	15	18	77
1981-1984	99	15	18	64
1999-2002	31	15	15	1

Noctuid communities in the centre of Warsaw have changed considerably over the last 50 years. They are now much poorer in terms of the number of species and this process has increased over the last 20 years. A group of 25–30 species including abundant species occurring in the centre of Warsaw has been a constant component of the community (Tables I and V).

The part of the community that has changed in time consists of not abundant species that are found sporadically in the centre of Warsaw (Tables I and V). This group has been reduced at least 70–90%. A number of species, associated with forest habitats – *Catocala fraxini*, *Zanclognatha tarsipennalis*, *Earias clorana* i *E. vernana* – have disappeared. However, these are not the only species missing. Other losses have included *Tyta luctuosa*, associated with dry grassy areas, *Emmelia trabealis*, found in various habitats, or *Agrotis vestigialis*, showing a preference for sandy habitats. Some of these species are regarded as few, while others are found all over Poland.

#### SUMMARY

The centre of a big city such as Warsaw represents a unique environment for living organisms. Although biologically active "islands" occupy only a small part of this habitat and are usually separated from larger green areas which function as refuges for the city's insects, such "islands" in the city centre are nevertheless penetrated by a large group of insects. Which species can be found in such areas, how did they get there and what are their chances for survival?

Being good flyers and often eurytopic, noctuid moths are a good study object. The larvae of most noctuid species do not show any significant feeding preferences, feeding on common herbaceous plants, more rarely on trees and bushes.

The centre of Warsaw has been penetrated by many species of noctuid moths (more than 40% of the total number of species recorded in Poland!). This can be easily seen in data regarding materials collected immediately after World War II, when Adamczewski captured over 60 noctuid species during just one year of catches (ADAMCZEWSKI 1951). At that time, the area looked rather different from what it is now, with most of the buildings razed to the ground during the war and with abundant ruderal vegetation providing a source of food for many noctuid species. The city also occupied a smaller area, the extent of war destruction was immense and human settlements were not far away from areas covered with natural vegetation in the suburbia. These neighbouring areas supported noctuid communities with very rich species composition also in the previous century (SLASTHEVSKY 1911, PATRYN 1947), functioning as a source of lepidopteran fauna for the city. However, most of these species would appear in the town only sporadically as for many of them the set of factors typical for an urban environment (most important: warmer and more arid climate, chemical pollution with exhaust fumes and other factors) was an barrier. Another group of noctuid species supplying city centre communities consisted of migratory species flying over the city attracted by the light of street lamps and shop displays. The centre also attracted a number of species inhabiting other habitats within the city,

e.g. parks, allotment gardens (which until quite recently extended over large areas even in the centre).

Since World War II, the centre of Warsaw has changed considerably. This most valuable part of the city underwent a period of intensive expansion, usually at the cost of the green "inland islands", which were also growing smaller due to natural factors. The indigenous vegetation usually disappeared and whatever was left was subject to intensive gardening practices. Raking, burning leaves or mowing killed immature individuals of numerous insects, including noctuid moths. Only urban vegetation that including abundant indigenous species and adequate diversity of surrounding areas can ensure the presence of a lepidopteran fauna consisting not only of generally common species but also those with special habitat requirements (as can be observed in the case of *Rhopalocera*) (WINIARSKA, in press).

In the absence of such conditions, most species could penetrate into this area, but can not colonize it, and the number of less abundant species was growing smaller. However, one group of species was invariably reported as abundant. These are generally common, eurytopic species reported from many anthropogenic habitats (eg. *X. c-nigrum*, *A. gamma*, *D. trifolii*, *M. pallens*, *M. l-album*, *A. exclamatoris*, *A. segetum*). Such species have been a constant part of the city centre communities. The question is: do they settle in the city centre or do they migrate into it in large numbers every year, during the period of their phenological activity, from adjacent areas where they are equally abundant? Some of them, such as *M. brassicae* or *Lacanobia oleracea*, certainly do, but an answer to the question what species settle in the city centre can only be provided by studies of their larval stages. This is a very difficult task as the larvae of noctuid moths can be found on various plants, often on their underground parts. Also, methods for large-scale sampling and estimating their abundance have not been developed yet. However, studies of urban habitats are attracting a growing number of scientists and such research is being undertaken in many other regions of Poland.

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## STRESZCZENIE

[Tytuł: Wieloletnie zmiany zachodzące w zgrupowaniach *Noctuidae*, *Pantheidae* i *Nolidae* (*Lepidoptera*) w centrum Warszawy]

Nasilający się proces urbanizacji wywołuje szereg zmian w środowisku, ograniczających występowanie większości gatunków roślin i zwierząt na obszarach poddanych jego wpływowi. Najtrudniejsze do zasiedlenia jest centrum miasta – gęsto zaludniony obszar o zwartej zabudowie, silnie zanieczyszczony i o zieleni niemal całkowicie kształtowanej przez człowieka. W takim właśnie środowisku od ponad

50 lat prowadzone są systematyczne badania nad składem gatunkowym zgrupowań sówek (*Noctuidae*) – jednej z największych rodzin motyli nocnych.

Terenem badań prowadzonych w latach 1999–2002 był obszar o powierzchni 0,5 km<sup>2</sup>, ograniczony ulicami Marszałkowską, Wilczą, Emilii Plater i Alejami Jerozolimskimi. Znajdował się on w najbardziej zabudowanej części śródmieścia Warszawy. Materiał zbierano przez 3 pełne sezony wegetacyjne – od marca do października każdego roku. Ogółem zebrano ok. 300 okazów z rodziny *Noctuidae*. Materiał porównawczy do analizy wieloletnich zmian zachodzących w zgrupowaniach sówek został zebrany w latach 1948–1984 (i częściowo opublikowany) przez Adamczewskiego oraz w latach 1976–1979 przez Winiarską. Przeanalizowano dane dotyczące ok. 7000 okazów. Stworzono także komputerową, faunistyczną bazę danych „*Noctuidae* w środowisku miejskim Warszawy”.

W centrum Warszawy stwierdzono występowanie 209 gatunków sówek (*Noctuidae*, *Pantheidae* and *Nolidae*), co stanowi około 41% ogółu gatunków z tych rodzin występujących w Polsce i około 69% liczby gatunków sówek stwierdzonych w całej aglomeracji warszawskiej.

Zgrupowanie to było bardzo zróżnicowane, zarówno pod względem składu gatunkowego jak i liczebności. Aż 174 gatunki (73,2%) należały do występujących sporadycznie i zaledwie 15 gatunków (7,2%) do bardzo licznych i licznych w tym środowisku. Gatunki o największej liczebności (*Xestia c-nigrum*, *Autographa gamma*, *Discestra trifolii*, *Mythimna pallens*, *Agrotis exclamationis*, *A. segetum*, *Mythimna l-album*, *Hoplodrina ambigua* i *Luperina testacea*) spotykane były podczas każdego roku prowadzenia badań. Są one związane przede wszystkim ze środowiskami otwartymi (także antropogenicznymi), a ich larwy żerują przeważnie na występujących pospolicie roślinach zielnych. Niemal wszystkie gatunki zaliczane do najliczniejszych w centrum miasta występowały również w innych typach zieleni miejskiej, przede wszystkim w parkach. Niektóre, jak *A. gamma* czy *D. trifolii* należały tam do licznych, a *X. c-nigrum*, *A. gamma*, *M. pallens* i *M. l-album* do stałych komponentów dla tego typu zieleni miejskiej. Gatunki rzadkie i bardzo rzadkie (podczas wieloletnich badań stwierdzano zazwyczaj ich pojedyncze okazy) stanowiły dominującą część zgrupowania sówek w centrum Warszawy. Większość tych gatunków występuje na terenie przetrwałym 50 lat w zgrupowaniach sówek występujących w centrum Warszawy zaszły wyraźne zmiany. Nastąpiło znaczne zubożenie ich składu gatunkowego, nasilone w ciągu ostatnich 20 lat. Trwały i niezmienny w czasie element tych zgrupowań stanowiła grupa 25–30 gatunków, składająca się ze wszystkich gatunków bardzo licznych i licznych oraz kilkunastu mniej licznych. Elementem zmieniającym się w czasie była natomiast grupa gatunków o niewielkiej liczebności, występujących sporadycznie w centrum Warszawy. Jej skład uległ zmniejszeniu o co najmniej 70%. Podstawową przyczyną znikania z centrum miasta gatunków rzadkich są, jak się wydaje, przede wszystkim niekorzystne zmiany środowiskowe zachodzące na skutek intensywnego zagospodarowywania tego obszaru (pustynnienie terenów gęsto zabudowanych, zmniejszanie się powierzchni zieleni miejskiej, zmiana składu gatunkowego roślinności, silne zanieczyszczenie i podobne czynniki).