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Zdzisław CMOLUCH, Alicja CMOLUCHOWA,
Lech LECHOWSKI, Jacek ŁĘTOWSKI,
Alicja MINDA-LECHOWSKA,
Katarzyna SĘCZKOWSKA, Zofia STĄCZEK

Insect Fauna Surrounding Lake Reservoirs of the Lublin Coal Basin

Fauna owadów zbiorowisk przyjeziornych Lubelskiego Zagłębia Węglowego

Фауна насекомых приозерных сообществ Люблинского угольного бассейна

The location of the Coal Basin in the hitherto agricultural Lublin Region, will lead to, permanent in its results, degradation of natural habitat. The area exploited of ledges in the first stage is that in the central part of the Basin to the North and North-East of Łęczna, in the Łęczna-Włodawa Lake District. Geological, soil, hydrological and climatic conditions of the region have been examined. The degree of knowing the flora of exceptionally numerous lakes and land habitats gives the basis to appreciate their high and sometimes even unique, natural value (3, 8, 11, 13, 26, 27, 29, 30).

A rich network of surface water, inaccessibility of the area and small population added to preservation of natural, sometimes primary character of many communities. However, a quickly proceeding process of synantropisation of vegetation has been recently observed. Considerable changes in this direction were due to the construction of the Wieprz—Krzna Channel (1954—1961) and to the drainage of large areas of the region. Ground water diversion, conversion of several big lakes into retention, cultivation and recreation reservoirs, caused a considerable draining of the area, leading even to drying up of several shallow lakes. The greatest devastation of the land flora has been observed in the communities surrounding the lake, valuable for peat-bog plant associations occurring there which require a high and permanent horizon of ground water. At the

same time, the drainage has considerably widened the meadow areas, making their intensive utilization possible.

The knowledge of fauna resources, besides zooplankton and ornithofauna, is fragmentary. Relatively few publications regarding the area contain the data concerning small systematic units or only scanty pieces of information about fauna (2, 4, 5, 9, 16, 19, 20, 22, 23, 25, 31).

It seemed purposeful, therefore, to undertake investigations of the insect fauna of the Lublin Coal Basin before investments started and exploitation has been initiated. In the cycle of these investigations there is made an attempt to determine the qualitative and quantitative composition of the insects' orders and of their species as well as their domination structure and their density. There have also been presented zoogeographic and ecological characteristics of the species from selected groups, being the object of detailed elaborations. It seems that the data regarding the present state of the insect fauna contained in this and subsequent publications will be useful in further studies on determining the degree of changes in the structure of the fauna, due to manifold effect of the man's economy.

The elaboration of entomofauna of the Lublin Coal Basin has been carried out within the subject: "The Structure and Dynamics of Quantity of the Insect Fauna of the Lublin Coal Basin" by the group of research workers from the Department of Zoology of Maria Curie-Skłodowska University under the direction of prof. dr hab. Zdzisław Cmoluch.

Heteroptera have been elaborated by: Alicja Cmoluchowa, Lech Lechowski; *Thysanoptera* — by Katarzyna Sęczkowska; *Coccinellidae* — by Zofia Stączek; *Curculionidae* — by Zdzisław Cmoluch, Jacek Łętowski, Alicja Minda-Lechowska. Besides, many thanks are due to the following technical assistants: Lech Anasiewicz, Małgorzata Balana, Teresa Mazurek, Izabela Woźnica who have participated in the investigations.

CHARACTERISTICS OF THE AREA

Investigations of the insect fauna have been carried out in the communities adjoining the lakes: Nadrybie (Kaniwola), Wytyckie (Wólka Wytycka), Dratów and Płotycze (Fig. 1). The stands situated at various distances from the pilot-mine (Bogdanka) in places of the anticipated dusty and gaseous emissions (the direction of most frequent winds).

Insects were collected from eight areas; two of them belonged to transitory peat-bogs — *Caricetum limosae* (stand I) and *Caricetum lasiocarpae* (stand II), two of them — to the high-sedges communities — *Caricetum gracile* (stand III) and *Caricetum elatae* (stand IV), whereas the remaining four (stands V—VIII) were meadows which originated through the draining bog habitats and peat-bogs. As

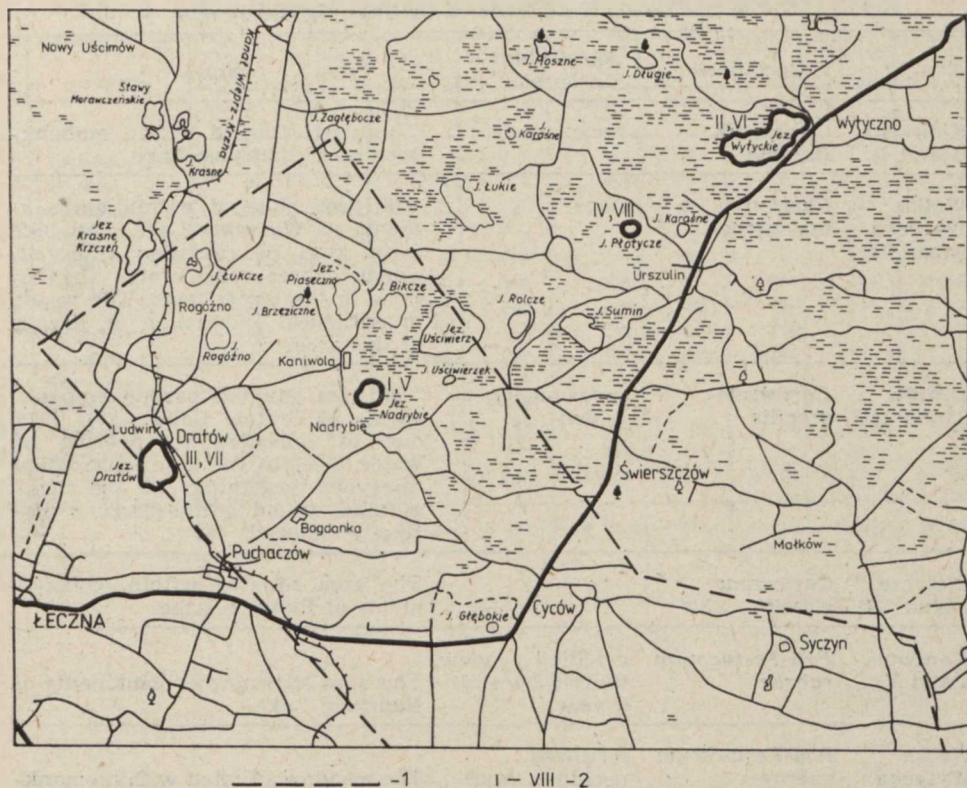


Fig. 1. A situation sketch of the area, 1 — the first stage of managing the Coal Basin, 2 — investigation stands

regards phytosociological aspect, it was included among *Poa-Festucetum rubrae* (10). The characteristics of the investigated habitats has been presented in Table 1.

The areas situated at the lakes: Nadrybie and Dratów (I, III, V, VII) were about 4 km from the developing Bogdanka mine, whereas the habitats situated at: Wytyckie lake and Płotycze lake (II, IV, VI, VIII) at a distance of about 20 km.

METHODS

The investigations were carried out in 1977—1980 upon eight lake areas. The samples were collected at regular intervals of 10 days during the whole vegetative season, i.e. from the beginning of May until October. Three methods were used for catching the insects: entomological net, momentary bioeconomometer and Barber's traps, however, the net was the main method. The zoeconological sample was a series of 8×25 catches with a net. By means of two other methods the insects have been collected only during one vegetative season of 1977. The renunciation of the use of these methods was conditioned by their small effectiveness during catching the insects of *Heteroptera*, *Thysanoptera* and *Coleoptera* (*Coccinellidae* and *Curculionidae*) orders — the group being the subject of detailed studies.

Table. 1. The characteristics of the investigated stands

Locality	Association	Agrotechnical measures	Notes
Kaniwola (stand I)	<i>Caricetum limosae</i>	none	The area situated within embankments of Nadrybie Lake
Wólka Wytycka (stand II)	<i>Caricetum lasiocarpae</i>	none	The area situated within embankments of Wytyckie Lake. The lake is a kind of retention reservoir, which causes considerable fluctuations in the water level. The result in periodical inundation or drying of this area
Dratów (stand III)	<i>Caricetum gracilis</i>	occasionally mown	The area situated beyond embankments of Dratów Lake. After 1978, due to considerable lowering of water level in the lake (cultivation reservoir) vegetation of the communities adjoining the reservoir distinctly changed
Plotycze (stand IV)	<i>Caricetum elatae</i>		The area situated within embankments of Plotycze Lake
Kaniwola (stand V)	<i>Poa-Festucetum rubrae</i>	calcified meadow, twice mown in a year	The area adjoining embankments of Nadrybie Lake
Wólka Wytycka (stand VI)	<i>Poa-Festucetum rubrae</i>	fertilized meadow, twice mown in a year	The meadow situated within embankments of Wytyckie Lake
Dratów (stand VII)	<i>Poa-Festucetum rubrae</i>	sown meadow, twice mown in a year	The meadow situated about 100 m from embankments of Dratów Lake
Plotycze (stand VIII)	<i>Poa-Festucetum rubrae</i>	fertilized, calcified meadow, twice mown in a year, occasionally pastured	The meadow adjoining embankments of Plotycze Lake

The quantitative materials obtained by means of net from the particular systematic groups have been elaborated with the use of following ecological indices: their number, domination and relative density (18, 28). Also the share of zoogeographical and ecological elements was taken into account (6).

ANALYSIS OF MATERIAL

In the result of investigations 95 220 insect specimens were found, representing 14 orders (Table 2). Most frequently obtained insects were those of *Diptera* order (56%) and *Homoptera* order (22.7%). The amount

Table 2. A list of insect species and their number at the particular stands

No.	Orders	Kaniwo-la	Wólka Wyticka	Oratów	Płotycze	Kaniwo-la	Wólka Wyticka	Oratów	Płotycze	Sum of specimens
		stand I	stand II	stand III	stand IV	stand V	stand VI	stand VII	stand VIII	
1	Ephemeroptera	19	-	-	-	-	-	-	-	19
2	Odonata	30	40	4	1	40	4	-	2	121
3	Orthoptera	399	124	149	20	653	255	183	249	2 032
4	Dermaptera	-	4	-	-	-	-	-	-	4
5	Psocoptera	2	-	1	-	4	-	-	-	7
6	Homoptera	3 191	1 869	3 463	358	5 506	2 467	3 594	1 174	21 622
7	Heteroptera	680	152	238	140	608	671	419	126	3 034
8	Thysanoptera	195	36	67	-	145	153	190	-	786
9	Coleoptera	2 006	1 036	1 544	742	1 891	498	1 245	111	9 073
10	Neuroptera	3	1	2	1	5	-	3	-	15
11	Mecoptera	-	-	-	-	2	1	-	-	3
12	Lepidoptera	109	47	67	64	82	21	86	3	479
13	Hymenoptera	808	223	721	103	1 329	468	907	159	4 718
14	Diptera	10 969	2 992	6 745	1 832	14 164	4 344	9 628	2 633	53 307
Total		18 411	6 524	13 001	3 261	24 429	8 882	16 255	4 457	95 220

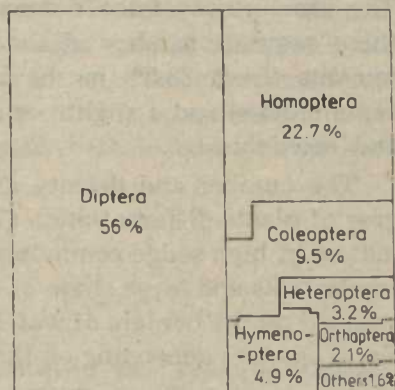


Fig. 2. The share of the particular insect orders in entomofauna of lake communities of the Lublin Coal Basin

of the other 12 orders was much less numerous and it constituted 21.3% of all the caught insects (Fig. 2).

When analysing the number of insects collected in three types of habitats it was found that the greatest abundance of fauna was characteristic of hay-growing associations (56.7%). In the other two communities 43.3% of insects were collected (in peat-bog associations — 26.2%, in sedge associations 17.1%).

Change in the density of entomofauna in the discussed plant communities showed the same system. The insects settling the hay-growing meadows associations were characterized by the highest density (over 310 specimens/sample), whereas among the high sedges communities the index reached the lowest value, ca 218 specimens/sample. The results of

investigations presented so far are in accordance with the data given by other authors (1, 12, 14, 21, 24) and they confirm the fact that cultivated meadows differ from the natural communities by higher number of insects.

The qualitative composition of order taxons forming the classes of numerical force of the particular communities did not show any significant differences, though they were connected with various plant formations (*Phragmitetea*, *Scheuchzerio-Caricetea fuscae*, *Molinio-Arrhenatheretea*). In the three types of communities the first six orders, arranged according to the decreasing value of the index of domination, occur in the same order. Also in each case there was observed a decidedly greater share (over 50%) of *Diptera* in relation to the other groups. Agrotechnical measures to which meadows associations were subject, did not negatively influence the numerical force and relative density of the taxon. Similar observations from the investigations of *Diptera* living upon artificial and natural meadows were made by Frydlewicz-Ciesielska (12).

The per cent share of the caught orders were very similar (Fig. 3). The comparison of the domination structures of the insects living upon these associations showed a decided prevalence of eudominants and dominants (from 88.5% in the boggy communities to 95.3% in the sedge communities) and a slight per cent share of further classes (subdominants and recedents).

The number and density of insects increased with increasing the degree of plants differentiation (Table 2, Fig. 3). Low values of the analysed indices in high sedge communities resulted from floral scantiness of those associations and large share of sedges (up to 90%). These associations were situated on the borders of water reservoirs and they were subject to strong floral changes depending on the horizon of ground water.

Heteroptera, *Thysanoptera* and the families: *Coccinellidae*, *Curculio-*

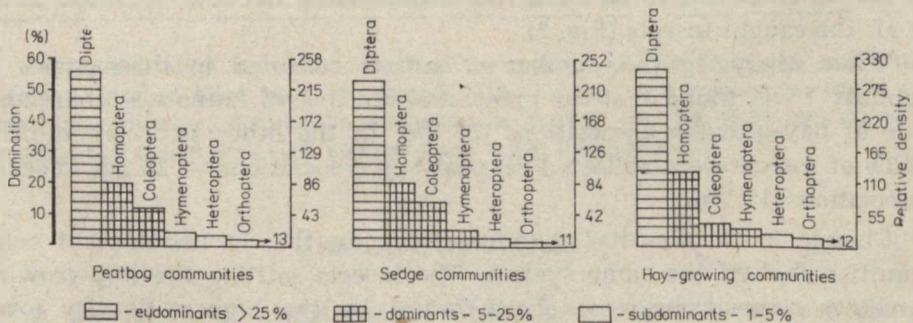


Fig. 3. Structures of domination and density of insects of lake communities of the Lublin Coal Basin

nidae were studied in detail. The species included there fulfil the conditions determining the formation in biocenosis of separate groups of the nature of association (15, 17). Therefore, the values of the discussed ecological indicators of those orders were subject to analysis.

The numerical value of *Heteroptera*, *Thysanoptera* and *Coleoptera* increased as the degree of differentiation of vegetation has increased: the high sedges communities — peat-bogs — hay-growing meadows. The density of insects of *Heteroptera* and *Thysanoptera* orders (sucking insects) was similar (Fig. 3), whereas in *Coleoptera* (gnawing insects) the density decreased. The observed decrease in the density of beetles in meadow communities could have been caused by agrotechnical activities: hay-making, pasturing and fertilizing.

Among the collected *Heteroptera*, *Thysanoptera*, *Coccinellidae* and *Curculionidae* species two trophic groups have been distinguished: phytophages and zoophages. The predatory *Thysanoptera* and *Heteroptera* were most numerous in high sedges associations (4% — *Thysanoptera* and 22.9% — *Heteroptera*), whereas in the other two types of communities their share mostly remained on the same level: *Thysanoptera* — 2% and *Heteroptera* — ca 12%. The majority of *Coccinellae* species collected upon the investigated area are the aphidophagous forms. The numerical force of those species was very high and similar in all the communities (over 90%). *Curculionidae* are entirely phytophagous both in adult forms and in all larval stages.

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STRESZCZENIE

Badania przeprowadzono w latach 1977—1980 na 8 powierzchniach różniących się typem siedliska i sposobem eksploatacji, w rejonie Lubelskiego Zagłębia Węglowego (ryc. 1). Wyróżnione w nich zespoły roślinne zaliczono do trzech formacji fitosocjologicznych: *Phragmitetea* (*Caricetum limosae*, *C. lasiocarpae*), *Scheuchzerio-Caricetea fuscae* (*Caricetum gracile*, *C. elatae*) oraz *Molinio-Arrhenatheretea* (*Poa-Festucetum rubrae*) — tab. 1. Do analizy wykorzystano owady zbierane czerpakiem z częstotliwością co 10 dni. Zebrany materiał opracowano w zakresie: liczebności, dominacji i zagęszczenia względnego owadów oraz porównywano ich zależność od stopnia zróżnicowania roślinności. Stwierdzono, że środowiska poddawane zabiegom uprawowym (zbiorowiska łąk kośnych) charakteryzuje większa ogólna liczebność owadów niż zespoły naturalne (wysokie turzycy i torfowiska przejściowe). Nie obserwowano także różnic w składzie jakościowym taksonów rangi rzędu, budujących przedziały liczebności, zaś poziomy dominacji odłowionych rzędów były bardzo podobne (ryc. 3). W zbiorze owadów pozyskanych na badanych powierzchniach formami najliczniejszymi (eudominanty) okazały się *Diptera* (56%). Spośród grup będących przedmiotem szczegółowych opracowań *Coleoptera* wchodziły w skład dominantów, *Heteroptera* — subdominantów, *Thysanoptera* — recedentów.

Ocena wpływu stopnia zróżnicowania roślinności na liczebność i zagęszczenie owadów wykazała, iż badane wskaźniki wzrastały od zbiorowisk wysokich turzyc do łąk kośnych. W zgrupowaniach owadów, mogących tworzyć w biocenozie formacje o charakterze zespołu, liczebność i zagęszczenie u *Heteroptera* i *Thysanoptera* (owady ssące) wzrastały, zaś u *Coleoptera* (owady zgryzające) liczebność zwiększała się, natomiast zagęszczenie malało (tab. 2, ryc. 3). Poddano również analizie udział grup troficznych (fitofagów i zoofagów) w wyżej wymienionych grupach owadów.

РЕЗЮМЕ

Исследования провели в 1977—1980 гг. в районе Люблинского угольного бассейна, на 8 участках, различающихся типом местообитания и способом эксплуатации (рис. 1). Выделенные здесь растительные ассоциации отнесли к трем фитосоциологическим формациям: *Phragmitetea* (*Caricetum limosae*, *C. lasiocarpae*), *Scheuchzerio-Caricetea fuscae* (*Caricetum gracile*, *C. elatae*) и *Molinio-Arrhenatheretea* (*Poa-Festucetum rubrae*) — табл. 1. В анализе использовали насекомых, собранных черпаком в интервале 10 дней. Определяли численность, доминанты, относительную плотность насекомых и зависимость этих факторов от степени дифференциации растительности. Установили, что участки, подвер-

гнутые культурной обработке (сообщества сенокосных лугов), характеризуются большей общей численностью насекомых по сравнению с естественными ассоциациями (осоки высокие и переходные торфяники). Не обнаружили существенных различий в качественном составе таксонов порядка отряда, строящих численные ряды, в то же время уровни доминантности отловленных отрядов были очень похожи (рис. 3). Среди собранных насекомых наиболее многочисленными формами (эудоминантами) оказались *Diptera* (56%). Среди групп, подвергнутых всестороннему анализу, *Coleoptera* входили в состав доминантов, *Heteroptera* — субдоминантов, *Thysanoptera* — рецедентов.

Оценка влияния степени дифференциации растительности на численность и плотность насекомых показала, что эти показатели увеличиваются от сообществ осок высоких до сенокосных лугов. В совокупностях насекомых, которые в биоценозе могут создавать формации, имеющие характер ассоциации, численность и плотность возрастали у *Heteroptera* и *Thysanoptera* (сосущие насекомые), в то же время у *Coleoptera* (грызущие насекомые) численность возрастала, а плотность снижалась (табл. 2, рис. 3). Анализировали участие трофных групп (фитофаги и зоофаги) в этих вышеназванных совокупностях насекомых.