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Anna ANASIEWICZ

Department of Plant Protection, Agricultural University, Lublin

THE BEES (*APOIDEA*, *HYMENOPTERA*) ON ALFALFA
(*MEDICAGO MEDIA* PERS.) PLANTATIONS

I. THE SPECIES COMPOSITION AND VARIATION OF FLIGHTS

ABSTRACT: The alfalfa plantations under observation were visited by honey bees, 104 wild bee species and 17 bumble-bee species. The length of a working day and the daily variations in the flights of individual species of the bees under study appeared to depend to a large extent on the body size of the individuals.

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1. INTRODUCTION

Alfalfa is an allogamous, and in most cases self-sterile plant. Its cross-pollination is accomplished due to the activity of insects, mainly the wild bees and bumble-bees (Juga 1961, Móczár 1961, 1962, Ruszkowski 1968, Jabłoński 1970, Benedek 1972, Sowa 1972). Honey bees play a less important role, but according to some authors, efficient pollination of a plantation may be assured if honey bees are

present in sufficient numbers (Grinfeld 1956, Anaferova 1957, Lecomte 1959, Pritsch 1963, Kropačova 1964, 1965, Obrtel and Šedivý 1965, Blagoveščenskaja 1968).

When setting up seed plantations it is important to know the population density of some of the wild species of *Apoidea* in the environment (Dylewska et al. 1970a, 1970b). In recent years a decrease of numbers of the wild solitary bees and bumble-bees has been observed. This process is related to the intensification of agriculture, the ever-increasing use of chemicals in the environment, and the destruction of wild vegetation the flowers of which are the source of nectar and pollen for numerous species of these insects during periods when there are no flowering crop plants utilised by man (Ruszkowski 1971a, 1971b).

In connection with the alarming process of dying out of the wild bee species it seems necessary to introduce artificial breeding and domestication of some of the species which are most useful to seed crop production. Studies towards this objective have been continued by many authors (Stephen 1960, Bohart 1963, Kodoušek 1963, Wójtowski 1963a, 1963b, 1963c, Holm 1965, Stephen and Osgood 1965, Zapletal 1966, Wójtowski and Wilkaniec 1969a, 1969b, Pouvreau 1970, Biliński 1973).

Although there have been many studies concerned with alfalfa seed production, the problem still remains open and many authors carry on multidirectional investigations.

The aim of my studies was to determine the species composition of the *Apoidea* found in the biocenose of flowering alfalfa, and to describe the variation in flights and the length of the working day of the most abundant species, which is of great importance for the assessment of their value as the pollinators of the plant under study.

2. DESCRIPTION OF STUDY AREA

Field observations on the visits of *Apoidea* in flowering alfalfa fields were carried out in the years 1966–1968 at seed plantations at Elizówka near Lublin, at Łabunie (in the environs of Zamość) and at Chełm Lubelski.

The acreage of the plantations varied between 0.75 and 2.00 ha. At Elizówka (on a loess soil underlain by a subsoil with limestone) the Puławy variety was cultivated, and at Łabunie and Chełm Lubelski (on a limestone soil with marl limestone in the subsoil) — the Miechów variety was grown.

The yield of seed at Elizówka was estimated at 10–20 kg/ha, and at the other localities — at 50–150 kg/ha.

Among the weeds that infested the plantations the following were the most frequently encountered species: *Tripleurospermum inodorum*¹, *Trifolium pratense*, *T. repens*, *Sonchus arvensis*, *Cirsium arvensis*, *Plantago lanceolata* and *Galium aparine*.

¹Plant names are given according to Szafer, Kulczyński and Pawłowski (1953).

3. METHODS

Field studies included direct observation and insect catching. The studies were carried out during the flowering season of alfalfa 2–3 times a week, 5 times each day, at the following times of the day: time I = 6³⁰–7³⁰, time II = 8³⁰–10⁰⁰, time III = 12⁰⁰–13³⁰, time IV = 15⁰⁰–16³⁰, time V = 17³⁰–18⁰⁰.

a. Observation of plots. Four random-selected plots, each 1 m² in surface area, were observed five times a day (at the above times of the day) for 15 min. each time; honey bees, wild solitary bees and bumble-bees were counted separately.

b. Catching the insects by the "pick out" method. Each sample-observation was followed by the catching of wild *Apoidea* for 15 minutes. Over a distance of about 200 m, across various parts of a field, a search was made for wild solitary bees and bumble-bees, and after being spotted the individuals were caught with a sweep net. On the basis of the material obtained by this method the species composition of the wild *Apoidea* was determined, as well as the daily variation in the visits of some of the more frequently-encountered species.

c. Observation of the behaviour of *Apoidea*. While studying the aim and the manner of visiting of alfalfa flowers by the insect pollinators, the more frequently-encountered and easy to recognise species of wild *Apoidea* were observed separately. The observation of the behaviour of the honey bee was also carried out separately.

4. WEATHER CONDITIONS

The best weather favouring the flights of *Apoidea* was recorded for June – at the beginning of the flowering season of alfalfa. During that period there were many very warm days with the duration of sun light up to 14 hours. The only exception was the June of 1967 when the weather was less bright at Elizówka than at Łabunie and Chełm Lubelski. In July and during the first ten days of August, that is, in the height of the flowering season of the plantations, there were too few hours of insolation, and it often rained. During the second and the third ten-day periods in August only occasional rainy days were recorded, and towards the end of the flowering season of alfalfa there prevailed weather conditions favouring the flights of *Apoidea*.

5. RESULTS

5.1. Bee visits to alfalfa plots

The following three groups were distinguished among the *Apoidea* visiting the alfalfa plots under observation: honey bees, wild bees and bumble-bees. In Table I are presented the results of the observations carried out during the full flowering season of the plantations, on days with a settled bright weather.

Tab. I. *Apoidea* visits to plots in the years 1966–1968

Plantation	<i>Apoidea</i> group	Number of:		Percentage of individuals working at time				
		observa- tions	total number of individuals	6 ³⁰ –7 ³⁰	8 ³⁰ –10 ⁰⁰	12 ⁰⁰ –12 ³⁰	15 ⁰⁰ –16 ³⁰	17 ³⁰ –18 ³⁰
Elizówka	the honey bee	860	6467	9.0	19.8	31.8	27.0	12.2
	solitary bees	860	214	3.5	20.0	45.6	28.5	2.4
	bumble-bees	860	101	12.9	22.1	28.4	26.7	9.9
Łabunie	the honey bee	680	6126	11.2	24.4	28.3	28.1	8.0
	solitary bees	680	115	15.0	27.4	40.0	16.1	1.4
	bumble-bees	680	25	11.7	21.6	39.3	18.4	8.8
Chełm Lubelski	the honey bee	860	5710	11.3	25.8	30.6	23.2	9.0
	solitary bees	860	228	6.7	24.2	44.3	21.7	3.0
	bumble-bees	860	64	5.9	35.1	22.3	23.7	13.0

Tab. II. Apoidea of the family Halictidae visiting alfalfa

Species	Number of individuals caught						
	Σ	Elizówka		Chełm Lubelski		Łabunie	
		♂	♀	♂	♀	♂	♀
<i>Rhophitoides canus</i> (Ev.)	754	321	168	76	97	82	10
<i>Halictus tumulorum</i> (L.)	200	48	45	14	33	39	21
<i>H. malachurus</i> (K.)	151		1	21	2	70	57
<i>H. calceatus</i> (Scop.)	117	7	13	44	21	13	19
<i>H. pauxillus</i> Sch.	63	7	4	7	3	9	33
<i>H. linearis</i> Sch.	51	2		2	1		46
<i>H. albipes</i> (F.)	37		6		20	1	10
<i>H. quadrinotatus</i> (K.)	30	7	6	4		8	5
<i>H. rubicundus</i> (Chr.)	25	4	16		1	1	3
<i>H. fulvicornis</i> (K.)	24	1	11			3	9
<i>H. laevigatus</i> (K.)	21					18	3
<i>H. subfasciatus</i> (Imh.)	21	1		2		18	
<i>H. laticeps</i> Sch.	19		8		3	3	5
<i>H. lativentris</i> Sch.	19	7	1	3	2	5	1
<i>H. maculatus</i> Sm.	18			1	1	3	13
<i>H. villosulus</i> (K.)	17		3	5	4	2	3
<i>H. minutus</i> (K.)	15				2	9	4
<i>H. zonulus</i> Sm.	15	2	4	3	1	5	
<i>H. eurygnathus</i> Blüthg.	14		2			6	6
<i>H. nitidiusculus</i> (K.)	14	2		8		2	2
<i>H. sextrigatus</i> Sch.	10			7		3	
<i>H. nigripes</i> Lep.	9		9				
<i>H. lucidulus</i> (Sch.)	6		1		2		3
<i>H. fasciatus</i> Nyl.	5	1			2		2
<i>H. leucozonius</i> (Schr.)	5			3	1	1	
<i>H. nitidus</i> (Pz.)	4	2			1		1
<i>H. viridianeus</i> Blüthg.	4	2	2				
<i>H. quadricinctus</i> (F.)	2	1					1
<i>H. fratellus</i> Pér.	3		1				2
<i>H. lateralis</i> Brullé	2				1		1
<i>H. minutissimus</i> (K.)	2		1				1
<i>H. tricinctus</i> Sch.	2	2					
<i>H. morio</i> (F.)	1				1		
<i>H. scabiosae</i> (Rossi)	1				1		
<i>H. xantopus</i> (K.)	1						1
<i>Halictoides dentiventris</i> Nyl.	1				1		
<i>Rhophites quinquespinosus</i> Spin.	1	1					
<i>Systropha planidens</i> Gir.	1					1	
<i>Sphecodes crassus</i> Th.	1						1

Honey bees were found to be most numerous, the workers of this species representing 92–99% of all the hymenopterans studied. On a plot under observation 2–4, and sometimes up to 7 worker bees worked concurrently. Solitary bees and bumble-bees working on flowers within the plots under observation represented jointly 1–8% of the *Apoidea* under study. The number of observed individuals varied considerably from year to year, and from locality to locality, the percentage of bumble-bees visiting alfalfa flowers being lower.

The percentage of honey bees among the individuals observed in flight over the plots was lower, ranging from 32 to 75%, while among the wild *Apoidea* as a rule bumble-bees predominated. The cause of this probably was the proximity of hairy-vetch and red-clover fields, which the bumble-bees visit in preference to alfalfa. It is possible that most of the individuals observed in flight over the plots were those flying to these plants, or back with loads to their nests.

Tab. III. *Apoidea* of the family *Apidae* visiting alfalfa

Species	Number of individuals caught						
	Σ	Elizówka		Chełm Lubelski		Łabunie	
		♂	♀	♂	♀	♂	♀
<i>Eucera longicornis</i> (L.)	47	3	34		2	2	6
<i>Anthophora quadrimaculata</i> (Pz.)	27	1	9	3	13	1	
<i>Clisodon furcatus</i> (Pz.)	5		3	1			1
<i>Nomada flavoguttata</i> (K.)	4					1	3
<i>N. errans</i> Lep.	1						1
<i>N. roberjeotiana</i> Pz.	1						1
<i>N. distinguenda</i> Mor.	1				1		
<i>N. armata</i> H.-Sch.	1					1	
<i>Psithyrus barbutellus</i> (K.)	23	13	9				1
<i>P. rupestris</i> (F.)	11	6	1			1	3
<i>P. campestris</i> (Pz.)	4	1	3				
<i>P. vestalis</i> (Fourer.)	4	2	2				
<i>Bombus ruderarius</i> (Müll.)	259	53	99	38	60		9
<i>B. terrestris</i> (L.)	209	16	138	5	27		23
<i>B. lapidarius</i> (L.)	134	1	43	2	35		53
<i>B. hortorum</i> (L.)	131	21	77	4	16	3	10
<i>B. silvarum</i> (L.)	116	1	21	1	56	1	36
<i>B. subterraneus</i> (L.)	82	30	38	3	9		2
<i>B. lucorum</i> (L.)	45	3	29	1	6		6
<i>B. muscorum</i> (F.)	42	1	10	1	25	1	4
<i>B. equestris</i> (F.)	29		15	2	4		8
<i>B. ruderatus</i> (F.)	28	13	12	1	1	1	
<i>B. distinguendus</i> (Mor.)	16	2	9	1	1	3	
<i>B. pomorum</i> (Pz.)	9				5		4
<i>B. hypnorum</i> (L.)	5	1	4				
<i>B. humilis</i> Ill.	4		2				2
<i>B. laesus</i> (Mor.)	4	1	3				
<i>B. agrorum</i> (F.)	3			1	2		
<i>B. confusus</i> (Sch.)	2	1					1

5.2. Review of the material gathered by using the "pick out" method

During the three-year period of field study a total of 4076 individuals of wild *Apoidea* was collected. The individuals represented 121 species belonging to 6 families.

The most numerous appeared to be the family *Halictidae* (Tab. II), being represented by 1686 individuals. Of the 39 species of this family the clearly dominating species was *Rhopitoides canus*². One of the individuals belonging to the species *Halictus pauxillus* was found to be gynandromorphous, with female qualities prevailing.

The family *Apidae* (Tab. III) was represented by a total of 1247 individuals, including 1118 bumble-bee individuals of 17 species (with *Bombus ruderarius* and *B. terrestris* dominating), and 8 species of wild bees represented by a total of 129 individuals.

The family *Andrenidae* (Tab. IV) comprised 367 individuals belonging to 24 species. 149 of the individuals of this family belonged to the species *Andrena gelriae*.

Tab. IV. *Apoidea* of the family *Andrenidae* visiting alfalfa

Species	Number of individuals caught						
	Σ	Elizówka		Chełm Lubelski		Łabunie	
		♂	♀	♂	♀	♂	♀
<i>Andrena gelriae</i> v.d. Vecht.	149	74	64	3	2	2	4
<i>A. propinqua</i> Sch.	70	3	65				2
<i>A. albofasciata</i> Th.	26	21		2		3	
<i>A. gravida</i> Imh.	18		11		3		4
<i>A. dorsata</i> (K.)	15		11		1		3
<i>A. bicolor</i> (F.)	13		5	2	4		1
<i>A. labialis</i> (K.)	12	1	3			3	5
<i>A. flavipes</i> Pz.	7		1		3		3
<i>A. ovatula</i> (K.)	6	5		1			
<i>A. chrysopyga</i> Sch.	5		1		1	2	1
<i>A. wilkella</i> (K.)	4	1	2				1
<i>A. combinata</i> (Chr.)	3		3				
<i>A. fulvicornis</i> Sch.	3					3	
<i>A. hattorfiana</i> (F.)	3					2	1
<i>A. nigrospina</i> Th.	3		3				
<i>A. carbonaria</i> (L.)	2	1	1				
<i>A. niveata</i> Friese	2						2
<i>A. florea</i> F.	2		1		1		
<i>A. bimaculata</i> (K.)	1						1
<i>A. floricola</i> Ev.	1					1	
<i>A. subopaca</i> Nyl.	1			1			
<i>A. falsifica</i> Perk.	1	1					
<i>A. schencki</i> Mor.	1	1					
<i>Panurgus calcaratus</i> (Scop.)	20	3		3	14		

²Full nomenclature has been given in Tables II–VII.

Tab. V. Apoidea of the family Melittidae visiting alfalfa

Species	Number of individuals caught						
	Σ	Elizówka		Chełm Lubelski		Łabunie	
		♂	♀	♂	♀	♂	♀
<i>Melitta leporina</i> (Pz.)	611	146	132	114	132	53	34
<i>M. haemorrhoidalis</i> (F.)	5			1		4	
<i>Dasypoda plumipes</i> (Pz.)	13		2	2	9		
<i>Macropis labiata</i> (F.)	1				1		

Tab. VI. Apoidea of the family Colletidae visiting alfalfa

Species	Number of individuals caught						
	Σ	Elizówka		Chełm Lubelski		Łabunie	
		♂	♀	♂	♀	♂	♀
<i>Colletes daviesanus</i> Sm.	61	3				28	30
<i>C. hylaeiformis</i> Ev.	1						1
<i>Prosopis communis</i> Nyl.	12		1	5	1	1	4
<i>P. minuta</i> F.	5					5	
<i>P. difformis</i> Ev.	3					1	2
<i>P. brevicornis</i> Nyl.	3					2	1
<i>P. hyalinata</i> Sm.	1				1		

Tab. VII. Apoidea of the family Megachilidae visiting alfalfa

Species	Number of individuals caught						
	Σ	Elizówka		Chełm Lubelski		Łabunie	
		♂	♀	♂	♀	♂	♀
<i>Megachile willoughbiella</i> (K.)	14	2	9		3		
<i>M. centuncularis</i> (L.)	10				8	1	1
<i>M. bombycina</i> (Pall.)	2	2					
<i>M. circumcincta</i> (K.)	1				1		
<i>M. ericetorum</i> Lep.	1						1
<i>Osmia fulviventris</i> (Pz.)	4						4
<i>O. atrocaerulea</i> Schill.	3						3
<i>O. adunata</i> (Pz.)	3				1	1	1
<i>O. cerinthidis</i> Mor.	1						1
<i>O. tuberculata</i> Nyl.	1			1			
<i>Chelostoma maxillosum</i> (L.)	1						1
<i>Ch. florisonne</i> (L.)	5			1	4		
<i>Heriades truncorum</i> (L.)	5				3	2	
<i>H. crenulatus</i> Nyl.	1				1		
<i>Anthidium manicatum</i> (L.)	6			4	2		
<i>Stelis phaeoptera</i> (K.)	2					2	

In the family *Melittidae* (Tab. V), with 630 individuals and 4 species, 611 individuals belonged to *Melitta leporina*.

The family *Colletidae* (Tab. VI) was represented by 86 individuals from 7 species. One of the species — *Colletes hylaeiformis* appeared to be new to the fauna of Poland. This is a bee occurring in xerothermic-plant associations. Kuntze and Noskiewicz (1938) found single individuals of this species on *Eryngium campestre* in the ravines of the Dniestr river in Podolia. The only female caught during the present study, on August 2, 1968, at Łabunie, was found to visit alfalfa flowers.

The least numerous family *Megachilidae* (Tab. VII) comprised 60 individuals belonging to 16 species.

5.3. The sequence of appearance of individual bee species on the alfalfa plantations under research

Mass visits of *Apoidea* to an alfalfa plantation are closely associated with the flowering season of this plant species. In 1966, the flowering of the first crop in the fields under observation began in the second ten-day period of June and continued until the first ten days of August. In 1967 and 1968 flowering began a little later — in the third ten-day period of June and ended in the middle of August. At Chełm Lubelski in 1966 the flowering of the second crop began in the first ten-day period of July and continued until the end of August.

The first to appear in alfalfa plantations were honey bee workers, then *Eucera longicornis*, this species already ending its flight, *Andrena gelriae*, *Halictus tumulorum*, *H. pauxillus*, *H. linearis*, *H. quadrinotatus*, *Colletes daviesanus* and *Megachile willoughbiella*. During the last days of June the following species appeared: *Melitta leporina*, *Rophitoides canus*, *Andrena propinqua*, *Halictus malachurus*, *H. calceatus*, *H. albipes*, *Anthophora quadrimaculata*, and the bumble-bees, *Bombus terrestris*, *B. lapidarius*, *B. ruderarius*, *B. hortorum* and *B. silvarum*. At this time there also occurred parasitic species of the genera *Nomada* F. and *Psithyrus* Gerst. The latest to appear in the plantations, as late as at the beginning of August, was *Dasypoda plumipes*.

The earliest to disappear from the plantations was *Eucera longicornis*; during the full flowering season of the first alfalfa crop only single individuals of this species were encountered. Bumble-bees, which at the end of the flowering season of the first crop, and during the full flowering season of the second alfalfa crop, appear to form numerous colonies, were observed to mass move to the red clover fields then entering the flowering season. This applied mainly to the longer-tongued species such as *Bombus lapidarius*, *B. hortorum*, and even *B. ruderarius* with a somewhat shorter tongue. The species that continued to visit alfalfa until the end of the flowering season was the short-tongued *B. terrestris*, although some individuals of this species were found to have also moved to red clover fields.

Honey bees abundantly visited alfalfa almost until the very end of the flowering season, even when there were only single flowers in the plantation.

5.4. Daily variations in flights, and the length of a working day of the bees

The time of the first appearance and work of the *Apoidea* visiting alfalfa during its flowering season varied with the individual species. The length of a working day was determined by weather conditions, the state of the flowering and nectar production processes of the alfalfa, and by the body size of the insects.

The honey bee. During the first flowering season of an alfalfa plantation the visits of honey bees usually began already before 7⁰⁰. The worker bees continued to work on the flowers until 17⁰⁰–18⁰⁰ hours, the time of maximum visits being between 10⁰⁰ and 15³⁰ hours (Fig. 1).

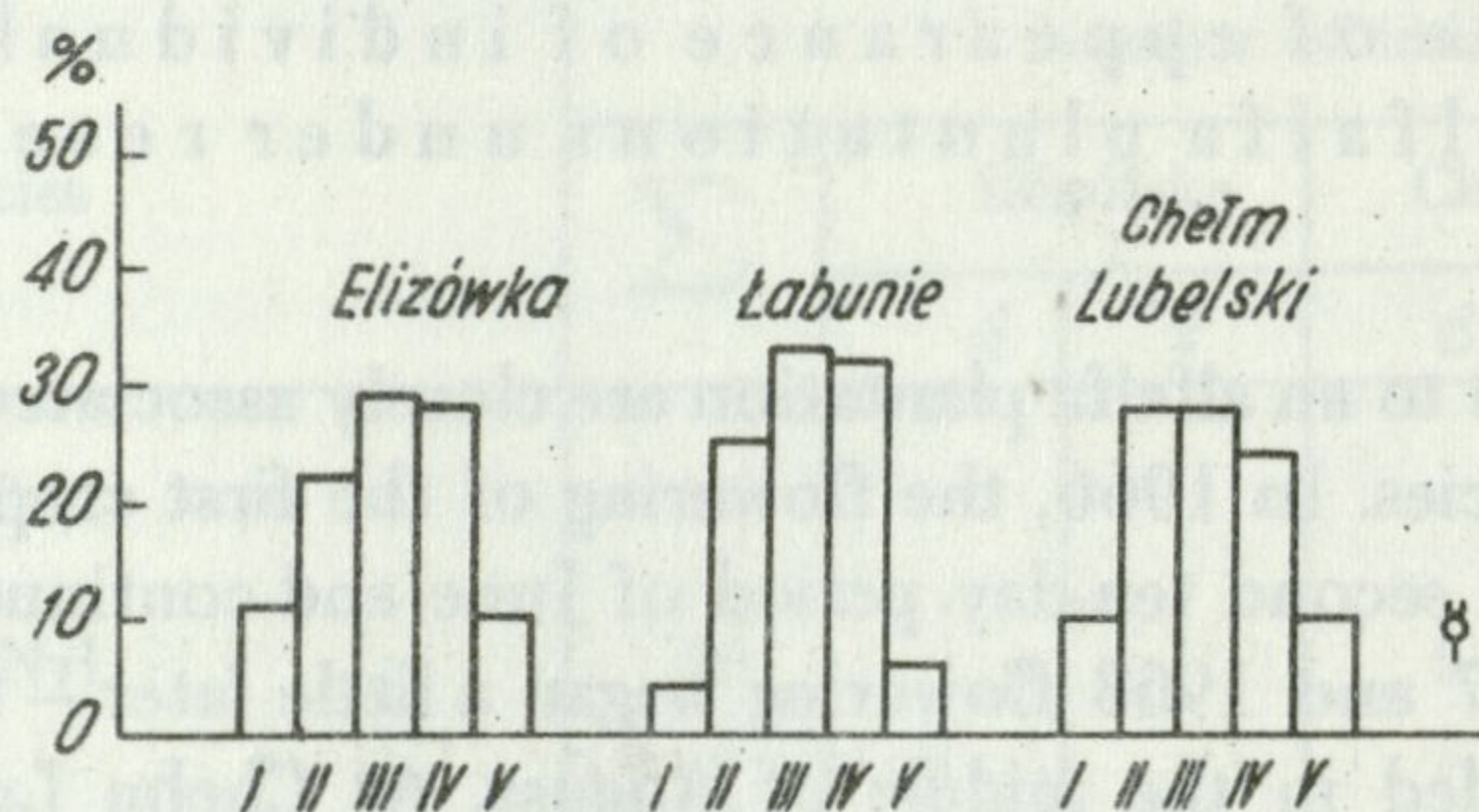


Fig. 1. Daily variation of flights of *Apis mellifica*

Time of catching: I – 6³⁰–7³⁰, II – 8³⁰–10³⁰, III – 12⁰⁰–13³⁰, IV – 15³⁰–16³⁰, V – 17³⁰–18³⁰

The wild solitary bees. Species of very small body size, whose body length never exceeded 7 mm, like for instance *Halictus pauxillus*, *H. quadrinotatus*, *H. lativentris*, *H. fasciatus*, used to begin to visit flowers relatively late, about 9⁰⁰–9³⁰ hours, and only sporadically could they be encountered before 9⁰⁰ hours. Their working day seemed not to exceed 6–7 hours in length. The slightly larger species, with a body length of up to 9 mm were seen on alfalfa flowers somewhat earlier, usually already before 9⁰⁰ hours, and as with the former group, they could still be seen as late as 18⁰⁰ hours; however, after 16³⁰ hours hardly any working individuals could be noted. This group included the following: *Rhophitoides canus*, *Halictus tumulorum*, *H. malachurus* (Figs. 2–4), *Andrena propinqua*, *A. albofasciata* and many others. The length of the working time of these species during the day may be estimated at 8–9 hours. Species with a body length over 9 mm were seen in the plantations earlier, often before 8⁰⁰ hours, and generally they worked longer. They could relatively frequently be seen still working on flowers as late as 18⁰⁰ hours. For instance, on bright days *Melitta leporina* used to begin to visit flowers not infrequently immediately after 7⁰⁰ hours, and most of the females could then be seen with considerable pollen loads (Fig. 5). Mass visits of this bee species occurred at noon, and a mass decrease in the numbers of observed individuals – after 17⁰⁰ hours. The time of intense working of this species may be estimated at 9–10 hours a day. A similar

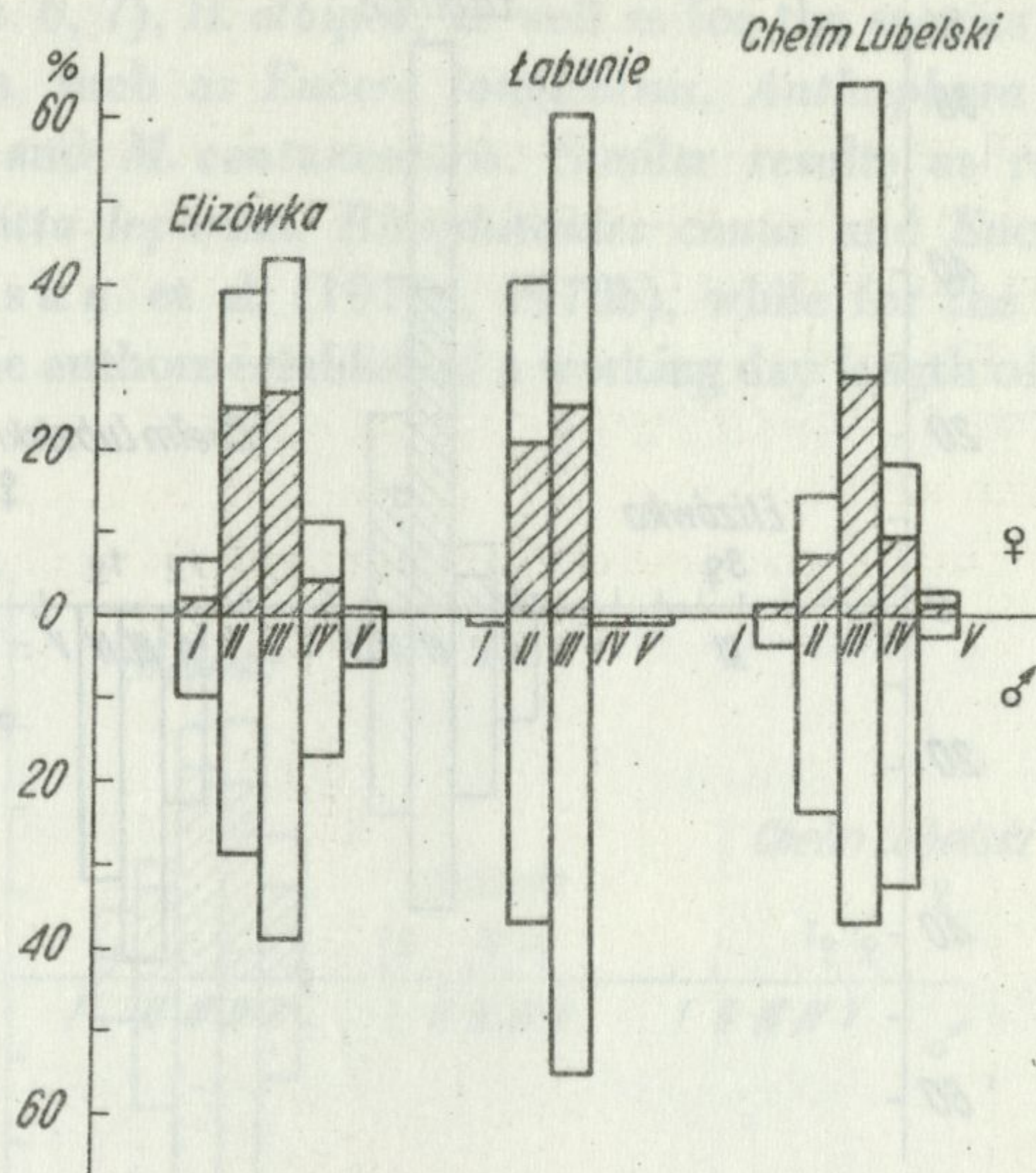


Fig. 2. Daily variation of flights of *Rhophitoides canus*

Shaded columns denote individuals carrying pollen. Other explanations the same as for Figure 1

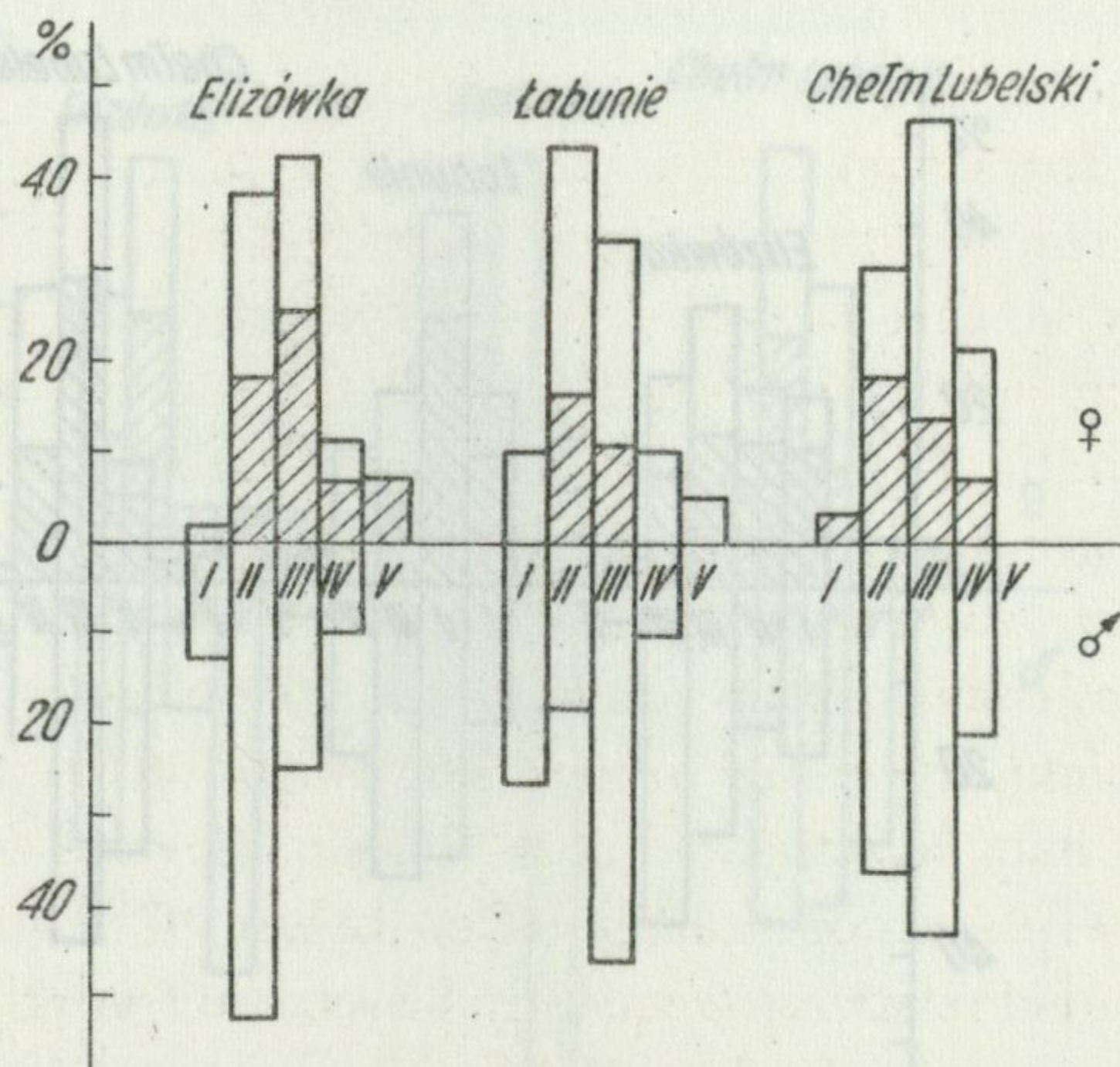


Fig. 3. Daily variation of flights of *Halictus tumulorum*

Explanations as for Figures 1 and 2

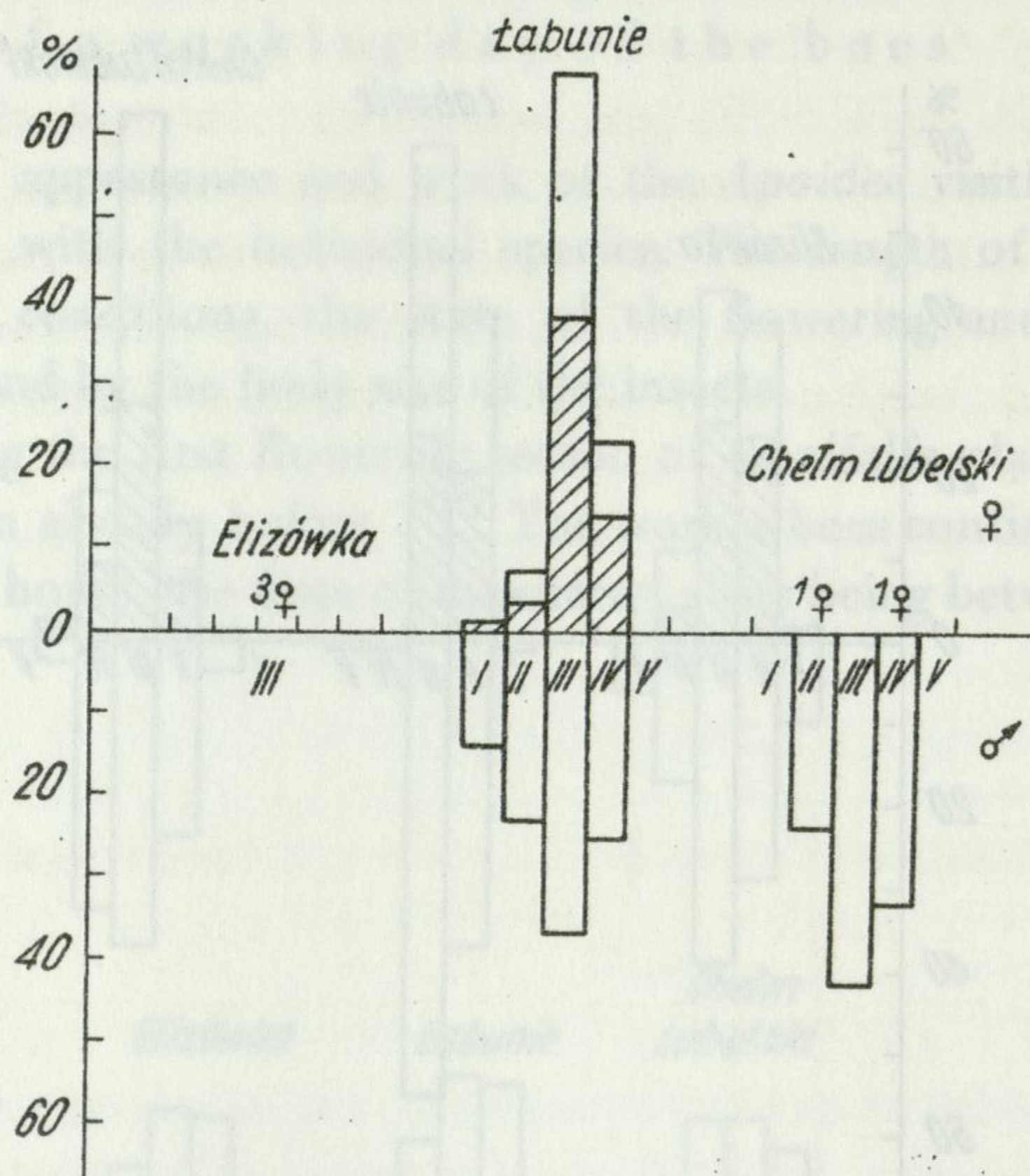


Fig. 4. Daily variation of flights of *Halictus melachurus*
 Explanations as for Figures 1 and 2

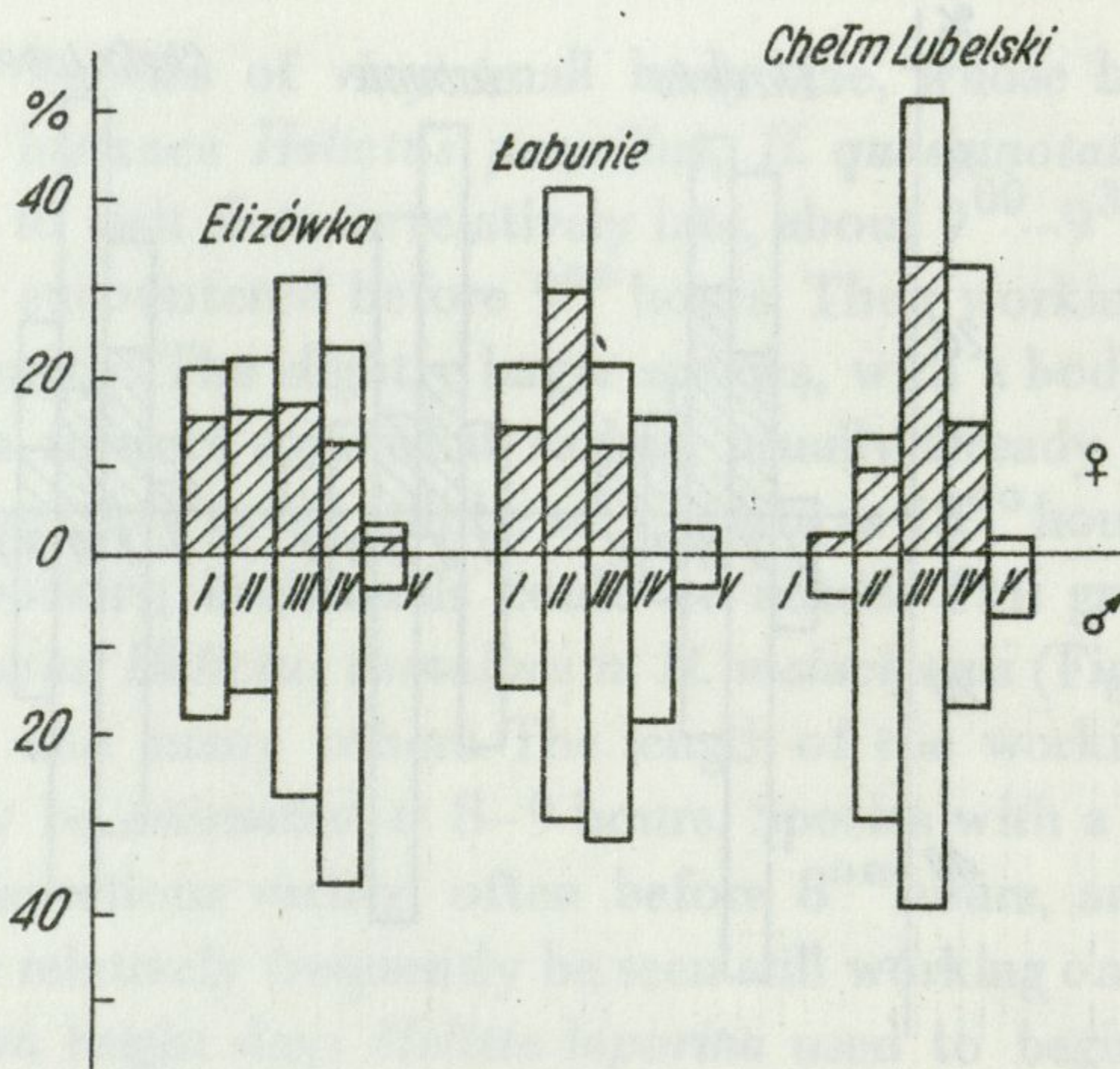


Fig. 5. Daily variation of flights of *Melitta leporina*
 Explanations as for Figures 1 and 2

value of the working day length may be estimated for the species: *Andrena gelriae*, *Halictus calceatus* (Figs. 6, 7), *H. albipes*, as well as for the species represented by small numbers of individuals, such as *Eucera longicornis*, *Anthophora quadrimaculata*, *Megachile willoughbiella* and *M. centuncularis*. Similar results as regards the length of a working day of *Melitta leporina*, *Rhophitoides canus* and *Eucera longicornis* were obtained by Dylewska et al. (1970a, 1970b), while for the species of the genus *Megachile* Latr. the same authors established a working day length of 6 hours.

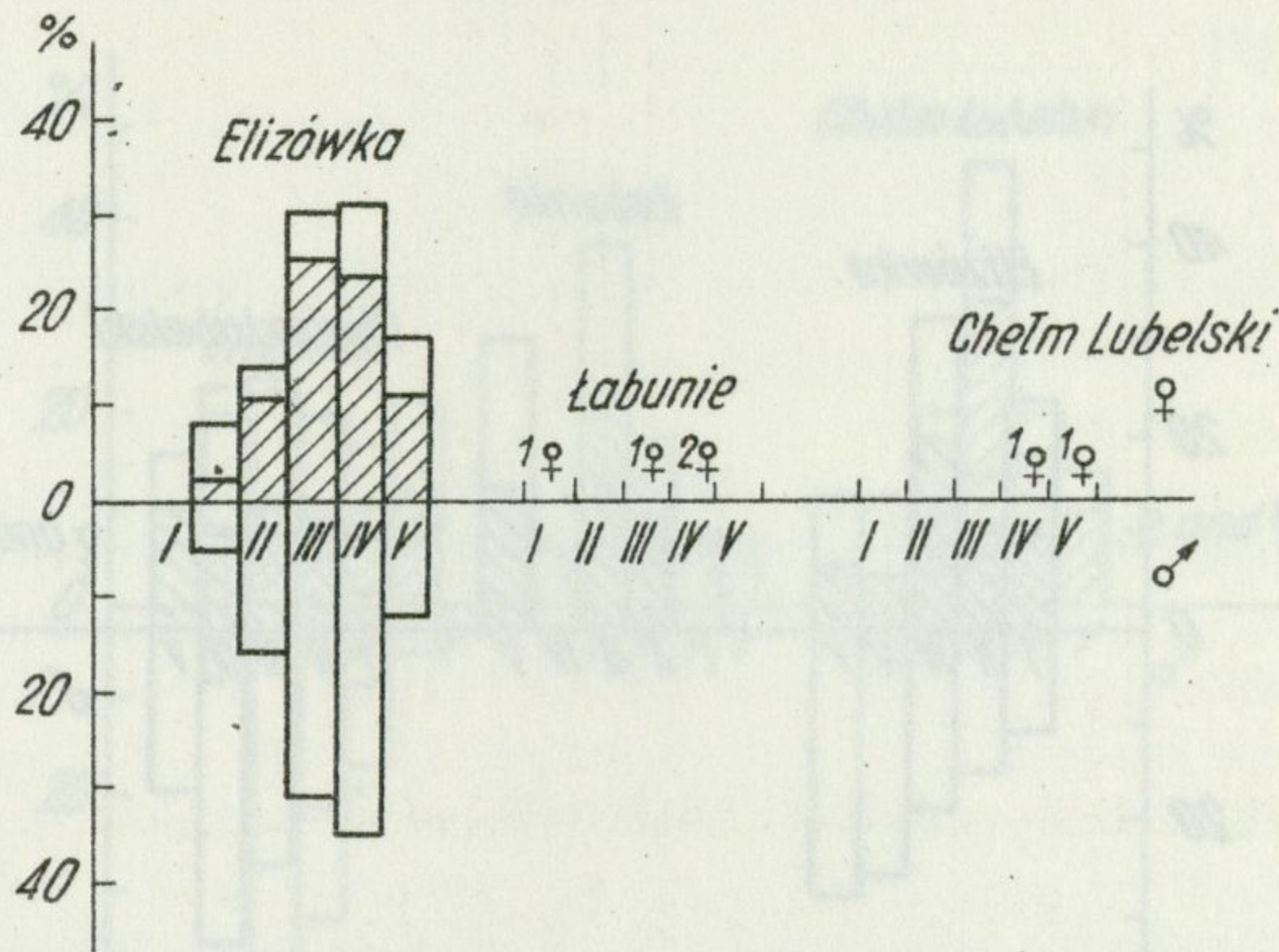


Fig. 6. Daily variation of flights of *Andrena gelriae*
 Explanations as for Figures 1 and 2

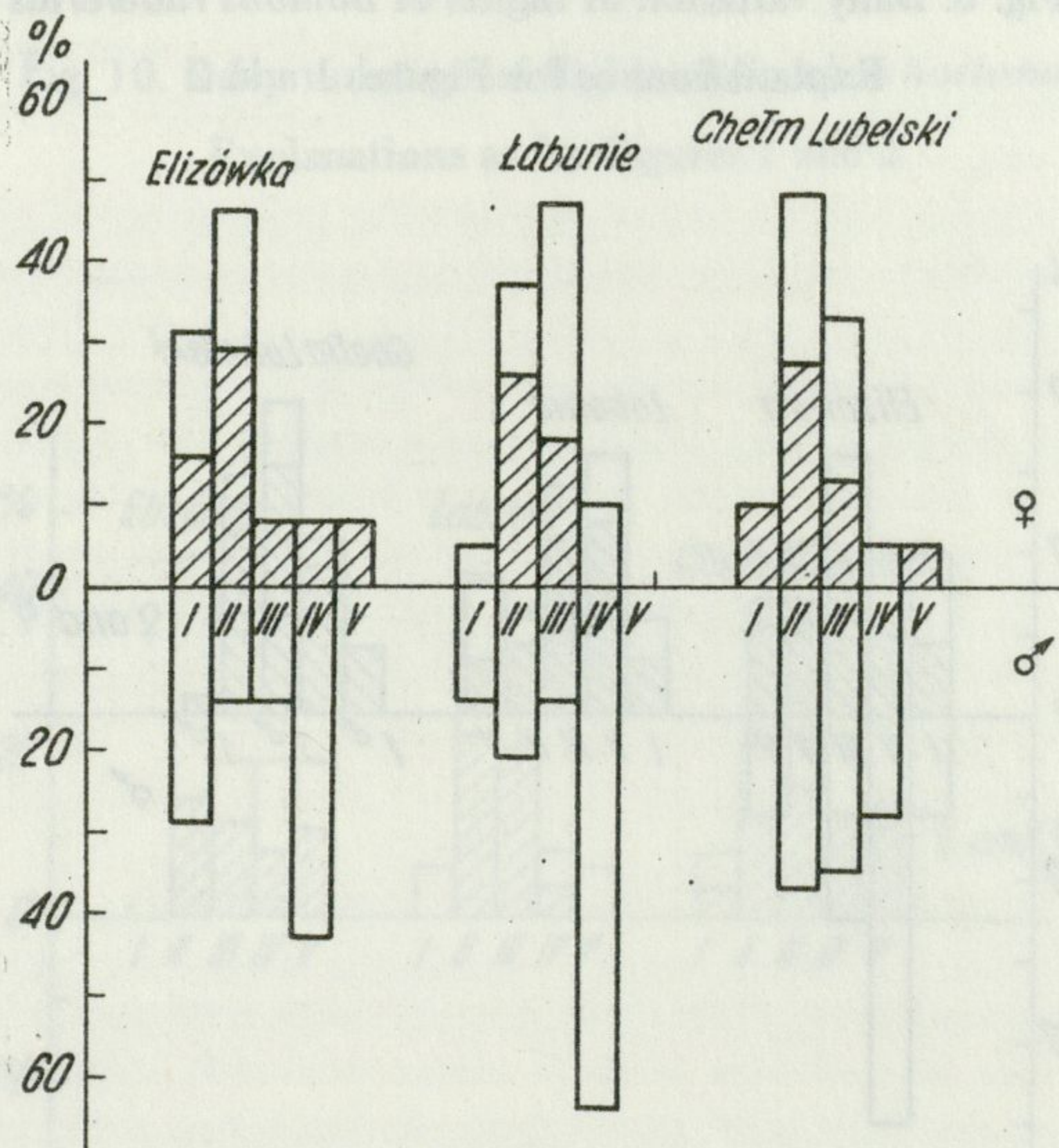


Fig. 7. Daily variation of flights of *Halictus calceatus*
 Explanations as for Figures 1 and 2

It was impossible to determine the duration of visits for the remaining wild solitary bee species because the numbers of individuals observed and caught were too small. It may only be stated that in general most of them were observed between 10⁰⁰ and 15⁰⁰ hours.

Bumble-bees were the first to appear on the plantations and they stayed there for the longest time. They could be seen there immediately after sunrise, as well as after sunset. Many individuals overtaken by dusk did not fly back to their nests but remained on the flowers overnight. On days without dew the working day of these insects began about 5⁰⁰ and ended after 18⁰⁰ hours. Dylewska et al. (1970a) estimate the working time of

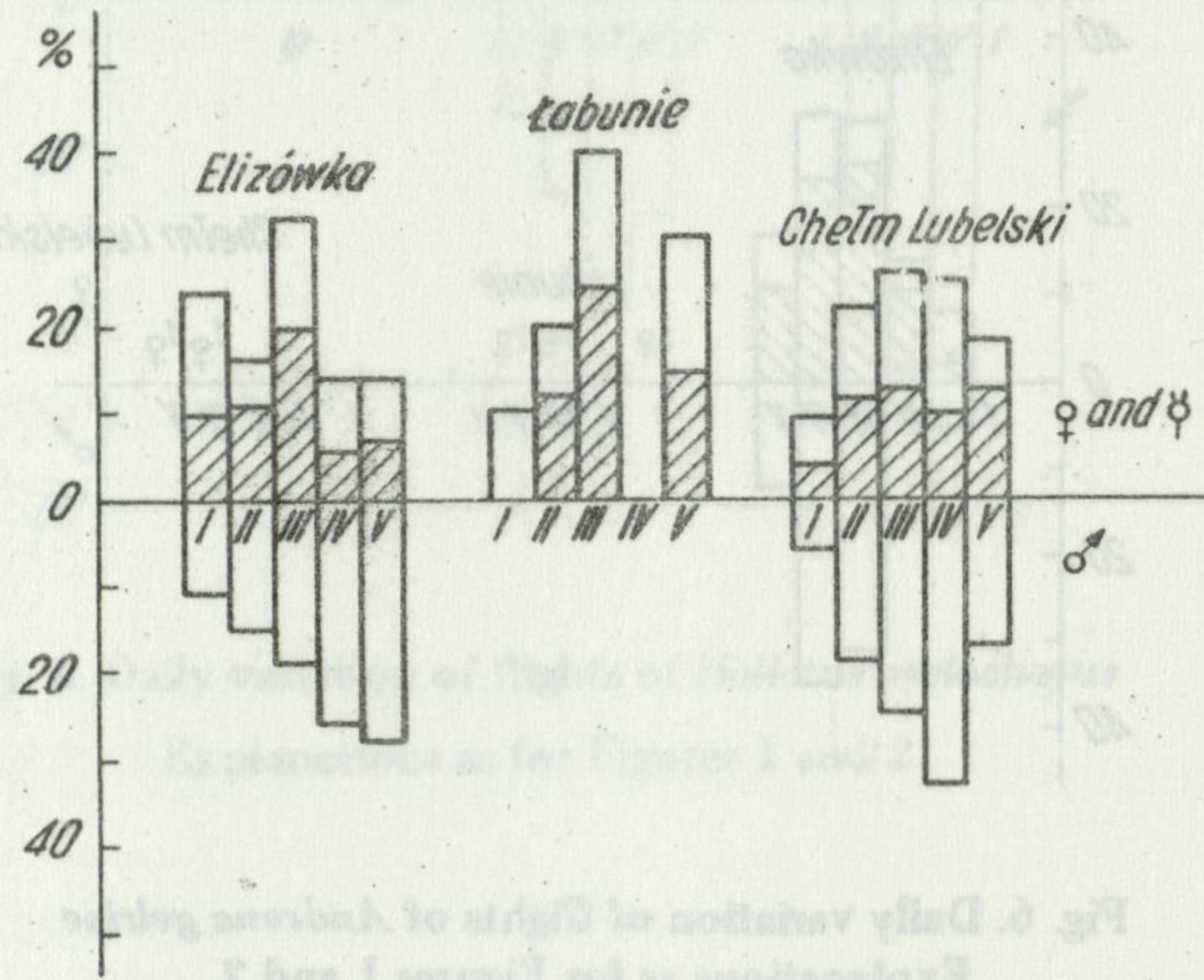


Fig. 8. Daily variation of flights of *Bombus ruderarius*
 Explanations as for Figures 1 and 2

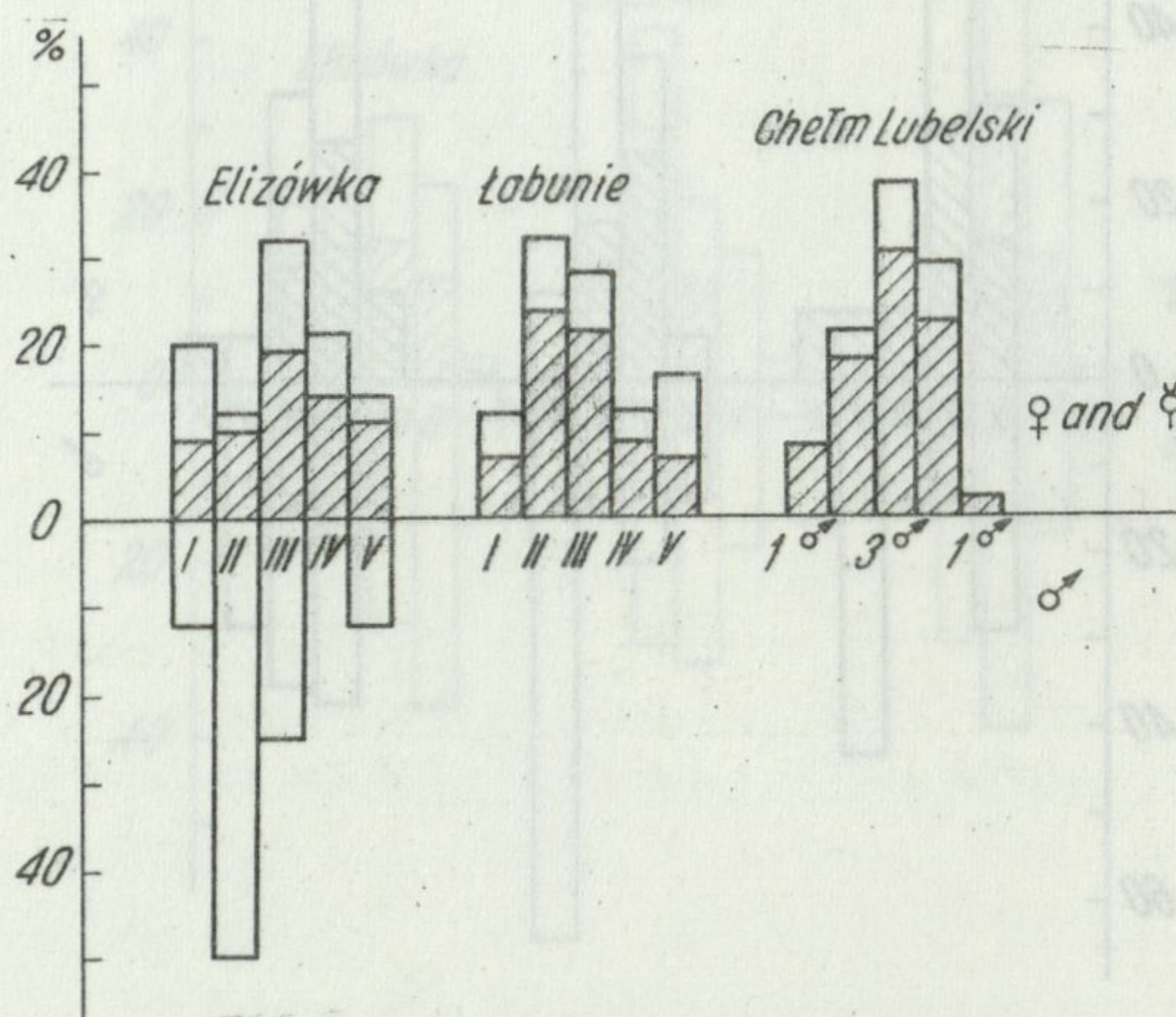


Fig. 9. Daily variation of flights of *Bombus terrestris*
 Explanations as for Figures 1 and 2

the bumble-bees at about 11 hours a day. The earliest to appear on the plantations, as early as immediately after 5⁰⁰, were *Bombus ruderarius* and *B. terrestris*, the most frequent species (Figs. 8–9). These were immediately followed by *B. hortorum*, *B. silvarum* and *B. lapidarius* (Figs. 10–12). As regards other species it would be difficult to attempt any conclusion as to the time of their visits to the plantations, because only single individuals were observed.

The data presented above relate to completely bright days.

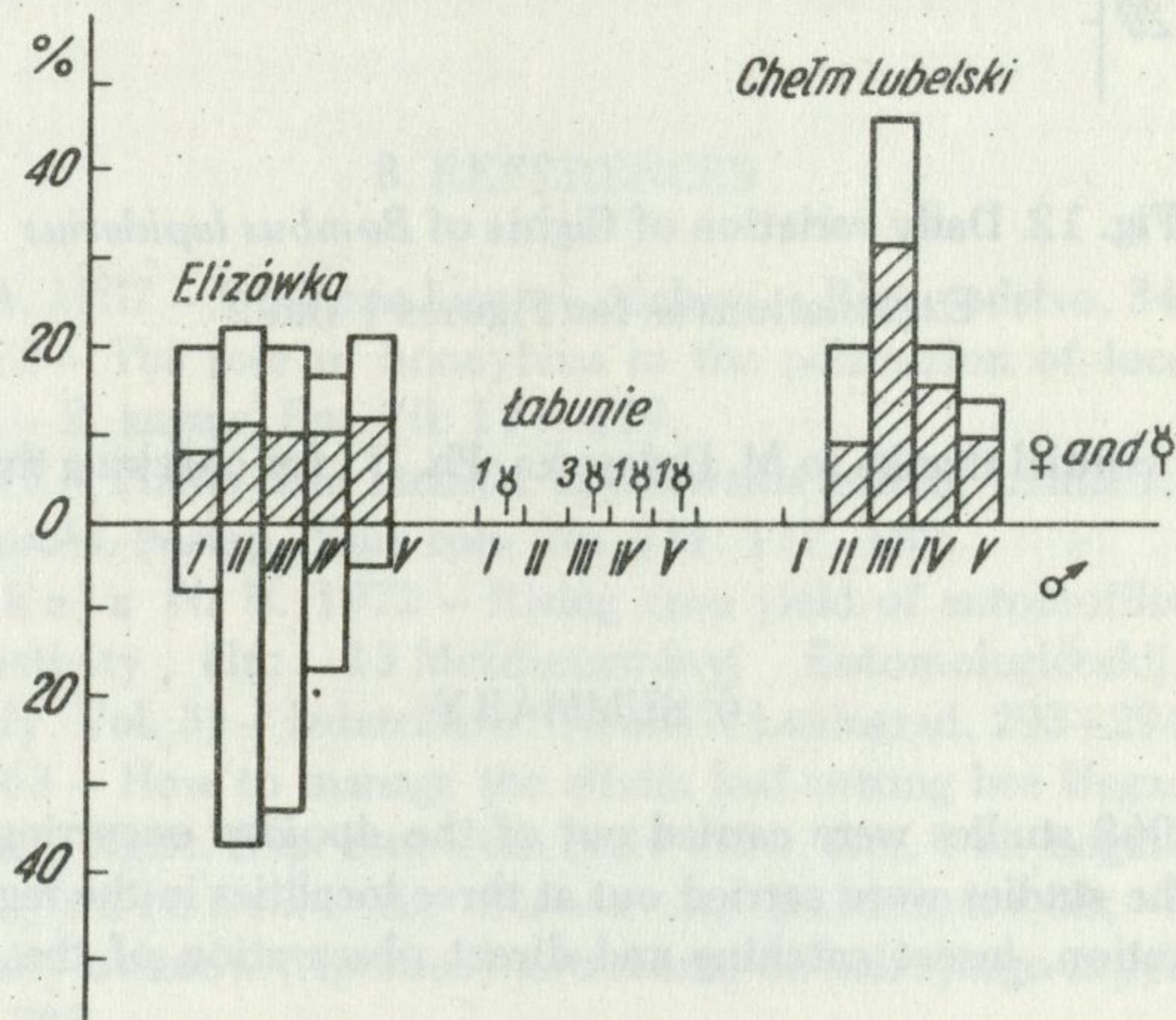


Fig. 10. Daily variation of flights of *Bombus hortorum*
 Explanations as for Figures 1 and 2

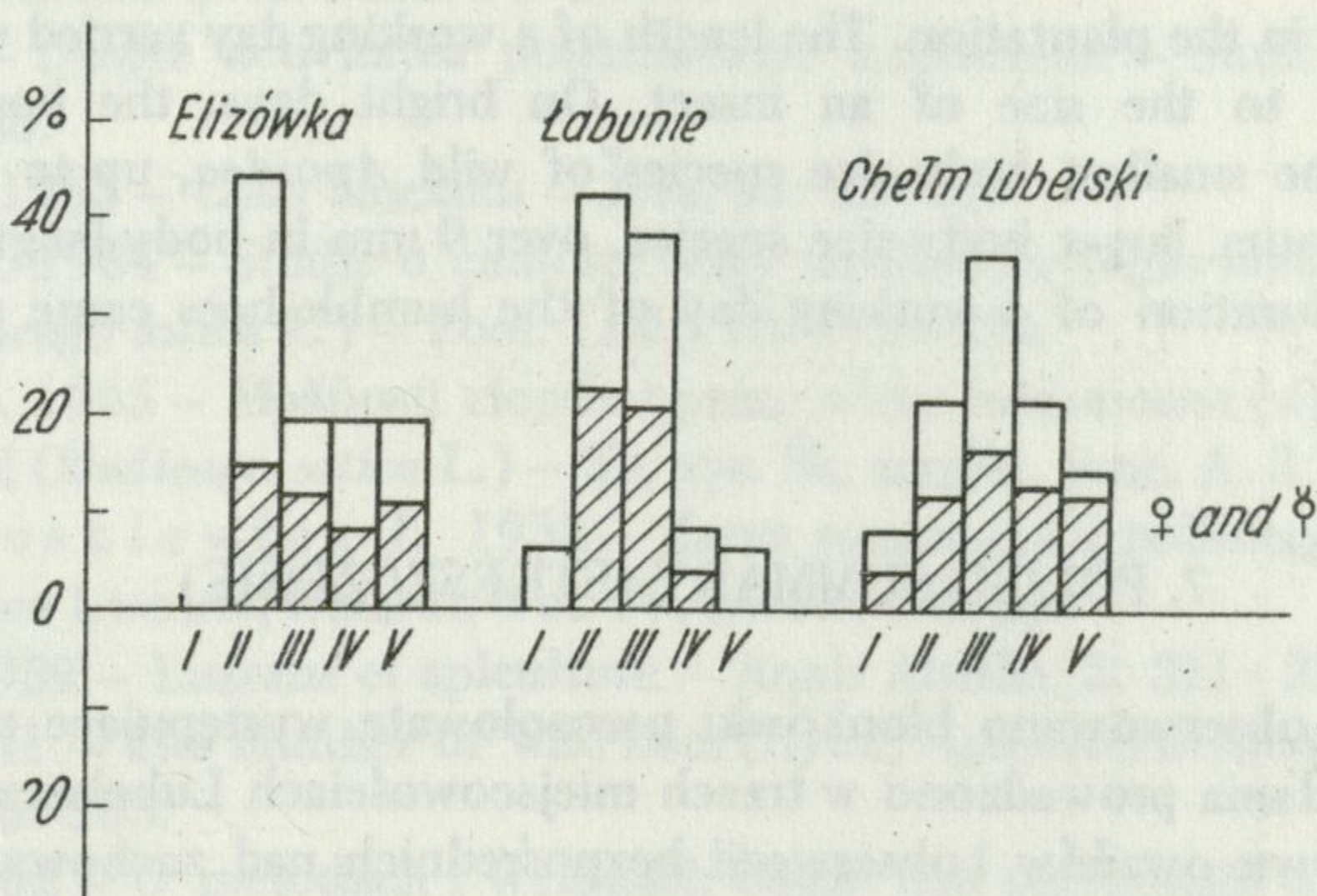


Fig. 11. Daily variation of flights of *Bombus silvarum*
 Explanations as for Figures 1 and 2

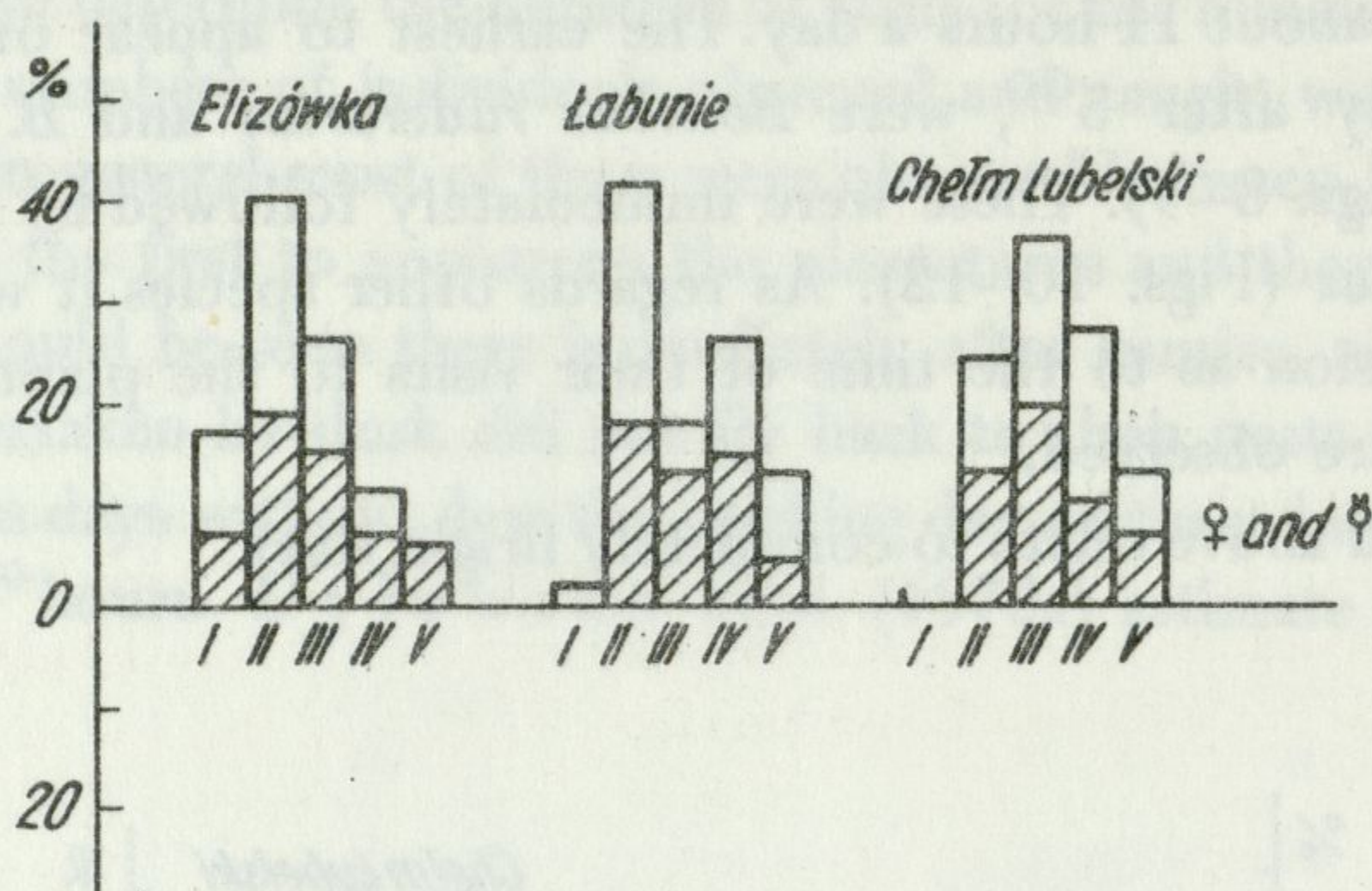


Fig. 12. Daily variation of flights of *Bombus lapidarius*
 Explanations as for Figures 1 and 2

I wish to express my cordial thanks to M. Dylewska, Ph. D., for checking the identification of some of the insects.

6. SUMMARY

In the years 1966–1968 studies were carried out of the *Apoidea* occurring in alfalfa fields during the flowering season. The studies were carried out at three localities in the region of Lublin, using the method of plot observation, insect catching and direct observation of the behaviour of the more abundant species.

The plantations under study were visited by the honey bee, 104 species of wild bees, and 17 bumble-bee species (Tabs. I–VII). The dominant species was the honey bee whose workers represented 92–99% of all the hymenopterans observed. The most frequent among the wild *Apoidea* were the following species: *Rhopitoides canus*, *Melitta leporina*, *Halictus tumulorum*, *H. malachurus*, *Andrena gelriae*, *Bombus ruderarius* and *B. terrestris*.

It seems that the contribution of the honey bees to the pollination of alfalfa flowers was small (1–2%), because the worker bees visited the flowers almost exclusively for nectar, reaching it through a slit at the side of the flower.

Daily and seasonal variation of the flights of the *Apoidea* depended on weather conditions and on the abundance of flowers in the plantation. The length of a working day varied with individual species and was clearly related to the size of an insect. On bright days, the honey bees worked for 10–11 hours (Fig. 1). The smallest body-size species of wild *Apoidea*, up to 7 mm in body-length, worked for about 6–7 hours, larger body-size species, over 9 mm in body-length – 9 up to 10 hours (Figs. 2–7), while the duration of a working day of the bumble-bees came up to 12 hours (Figs. 8–12).

7. POLISH SUMMARY (STRESZCZENIE)

W latach 1966–1968 obserwowano błonkówki pszczołowate występujące na plantacjach lucerny w okresie kwitnienia. Badania prowadzono w trzech miejscowościach Lubelszczyzny stosując metodę obserwacji poletek, odłowu owadów i obserwacji bezpośrednich nad zachowaniem się liczniejszych gatunków.

Badane plantacje były oblatywane przez pszczołę miodną, 104 gatunki dzikich pszczół samotnych oraz 17 gatunków trzmieli (tab. I–VII). Dominowała pszczoła miodna, której robotnice stanowiły 92–99% wszystkich obserwowanych błonkówek. Wśród dzikich pszczołowatych najliczniej wystąpiły

gatunki: *Rhophitoides canus*, *Melitta leporina*, *Halictus tumulorum*, *H. malachurus*, *Andrena gelriae* oraz *Bombus ruderarius* i *B. terrestris*.

Wydaje się, że udział pszczoły miodnej w zapylaniu kwiatów lucerny na badanych plantacjach był niewielki (1–2%), ponieważ robotnice zbierały niemal wyłącznie nektar, sięgając po niego poprzez szparę z boku kwiatu.

Dzienna i sezonowa dynamika lotu błonkówek pszczołowatych zależały od czynników pogody i stanu kwitnienia plantacji. Długość dnia pracy poszczególnych gatunków była różna i wyraźnie wiązała się z wielkością ciała owada. Pszczoła miodna w ciągu pogodnego dnia pracowała 10 do 11 godzin (fig. 1). Najmniejsze gatunki dzikich pszczół, których długość ciała nie przekracza 7 mm, pracowały około 6–7 godzin, gatunki większe, o długości ciała ponad 9 mm – 9 do 10 godzin (fig. 2–7), a czas pracy trzmieli w ciągu dnia dochodził do 12 godzin (fig. 8–12).

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Paper prepared by H. Dominas

AUTHOR'S ADDRESS:

Doc. dr habil. Anna Anasiewicz
 Instytut Ochrony Roślin AR
 ul. Akademicka 15
 20–934 Lublin
 Poland.