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Vole and Mouse Plagues in South-Eastern Poland in the Years 1945–1967

[With 2 Tables & 8 Figs.]

Fluctuations in the number of field rodents were studied in three provinces of South-Eastern Poland (Kielce, Kraków and Rzeszów, 53,505 sq.km). The information was derived from field studies, inquiries, and from the Service of Plant Protection. The mass appearance of rodents is caused mainly by the common vole (*Microtus arvalis*), with a local presence of mice and other voles (*Apodemus agrarius, Micromys minutus, Mus musculus, Arvicola terrestris*). Zones of chronic and sporadic vole plagues, as well as regions of slight changes in vole numbers, have been demarcated. Chronic plagues are common in poorly wooded regions with fertile soils. In areas unfavourable in respect of configuration, soil and abundance of forests (*e.g.* mountains) vole and mouse plagues occurred only during disturbances of farming. The mass appearance of voles recurred in 4-year cycles (1946, 1949, 1956/57, 1959, 1963 and 1966) and was usually synchronized with similar plagues in the neighbouring European countries. Damages to the field crops caused by voles at different population densities were estimated by a simple bioenergetic method.

I. INTRODUCTION

The mass appearance of field rodents in Poland recurs periodically, every 4 years in approximation (Kuntze & Szynal, 1934; Kuntze, 1937; Simm & Skuratowicz, 1950; Skuratowicz 1957, 1963). The common vole, *Microtus arvalis* (Pallas, 1779) is the most abundant species during these outbreaks, while the striped field mouse, *Apodemus agrarius* (Pallas, 1771), the house mouse, *Mus musculus* Linnaeus, 1758 and the harvest mouse, *Micromys minutus* (Pallas, 1771) are less common and appear only locally.

Mainly western and north-western regions of Poland are experience exposed to vole and mouse plagues (Simm & Skuratowicz, 1950; Skuratowicz, 1963). This paper extends the picture of rodent fluc-

tuations to south-eastern part of the country in the period 1945—1967. Common features of three provinces covered by the investigations consist in rather mountainous configuration of the terrain and hence in a similar type of farming.

The study was aimed to demarcate regions in South-Eastern Poland particularly affected by vole and mouse plagues and to show fluctuations of rodent numbers during 23 years (1945—1967).

II. THE STUDY AREA, MATERIAL AND METHODS

The area of three provinces studied, Kielce, Kraków and Rzeszów covers 53,505 sq.km [1]) and lies in the range of four geographic regions (Fig. 1; I—IV). The north-eastern part of Kielce province belongs to the zone of plains (I). A major part of this province and the north-western part of Kraków province is occupied by Old Mountains and Uplands (II). Flat Subcarpathian Valleys (III) stretch in northern parts of Rzeszów and Kraków provinces, while southern part of these provinces belongs to Carpathian Mountains (IV).

Rural economy of these regions includes both farming and stock raising. The area of arable land is relatively high (U h o r c z a k, 1969) and it reaches 66.8% in Kielce, 63.6% in Kraków, and 64.2% in Rzeszów provinces [2]). Forests occupy in these provinces 24.8, 26.7 and 32.3% of the area, respectively. Almost half of the arable land is sown in grain and the remaining grounds are used for root crops, pastures and meadows.

The whole area of the provinces under investigation has been divided into 10 zones (Fig. 1), each consisting of a few districts showing a similar population density of rodents.

Material for the study was obtained from three sources: (1) field investigations and observations, (2) inquiries, (3) data supplied by the Service of Plant Protection.

(1) Field studies, carried out mainly in 1954—57, depended on the inspection of cultivated fields in various seasons, and on trapping of rodents. The animals were captured by the method of trap-nights or removal, as well as by direct digging up of burrows. The number of rodents was also estimated from the number of open burrows after previously stamping them flat (S i m m & S k u r a t o w i c z, 1950).

(2) The inquiries were sent in 1957—58 to various persons in all villages of the studied provinces. The questions were simple and unequivocal, and concerned normal and increased appearance of rodents. The inquiry contained also an essential description of the most common field rodents (voles, water voles, mice, hamsters). Mailing of inquiries was preceded by an explanatory broadcast in the local radio programme. The inquiry was addressed to people directly associated with rural economy (farmers, directors of State Farms, agronomists, instructors of Plant Protection, forest officers and country teachers). From the total number of 6,170 mailed inquiries, and 1,230 inquiries sent for the second time, 2,833 answers were obtained. This figure includes the data from over 90% of villages. From many localities several inquiries were returned filled by independent informers. Contradictory answers were omitted in the analysis of results.

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[1]) [2]) After »The Statistical Yearbook, GUS 1968«, Warszawa 1968.

(3) General information on the outbreaks of field rodents and attempts of their control in the period 1945—1967 was obtained from Plant Protection Service Centres in Kielce, Kraków and Rzeszów. Some valuable additional estimations of rodent numbers were collected from the instructors of Plant Protection in a dozen or so districts. Such estimations are usually carried out in various plant cultures and based on counting of inhabited rodent burrows on 100 sq. m plots (spring and autumn), as well as on trapping (mainly in winter).

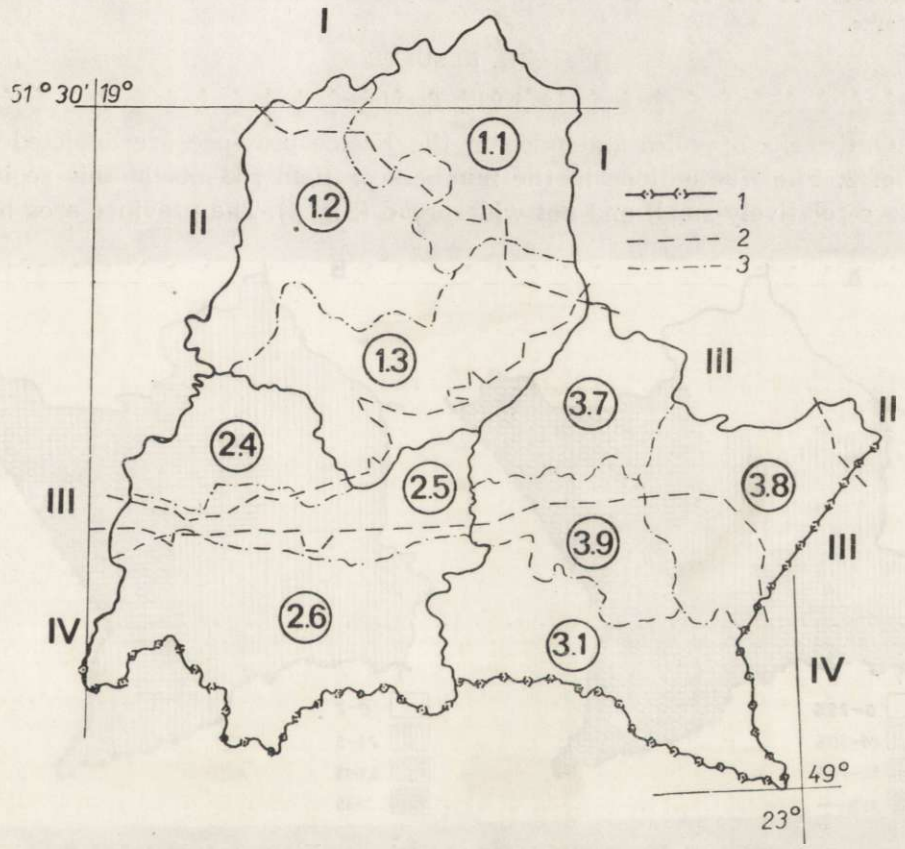

Fig. 1. Schematic map of the studied area of South-Eastern Poland.
1 — frontiers of the state and of three provinces, 2 — frontiers of geographic regions (I. Mazowiecko-Padlaska Plain, II. Małopolska Upland, III. Subcarpathian Valleys, IV. Carpathian Mountains). 3 — borders of zones in which appearances of field rodents are discussed (1.1, 1.2, 1.3 — Kielce province; 2.4, 2.5, 2.6 — Kraków province; 3.7, 3.8, 3.9, 3.10 — Rzeszów province).

In the period 1945—57 information was derived from these three sources, while in the next decade, materials collected by local workers of Plant Protection Service constituted the principal source. All the data were plotted as coloured points on maps in the scale 1:300,000, then generalized in the scale 1:1,000,000, as presented (Fig. 2, 4 and 6).

The intensity of vole and mouse plagues in consecutive years is depicted in diagrams (Fig. 3, 5 and 7). In the period 1945—57 this intensity is expressed as percentage of villages with a clear outbreak of rodents, while in the period 1958—67 the population density of rodents (number of inhabited burrows per 100 sq. m sampling plot) constituted the direct measure. The first method of estimation is based mainly on inquiry data and field inspections, and shows rather the distribution of plagues, while the second one is based on the material obtained from the Plant Protection Service and depicts local changes in rodent numbers. The two methods are not fully comparable but they allow determination »mouse plague years«.

III. RESULTS

1. Kielce Province

Outbreaks of voles and mice in the Kielce province are depicted in Fig. 2. The fluctuations in the numbers of field rodents in this region were relatively small and not widespread (Fig. 3). The province area has

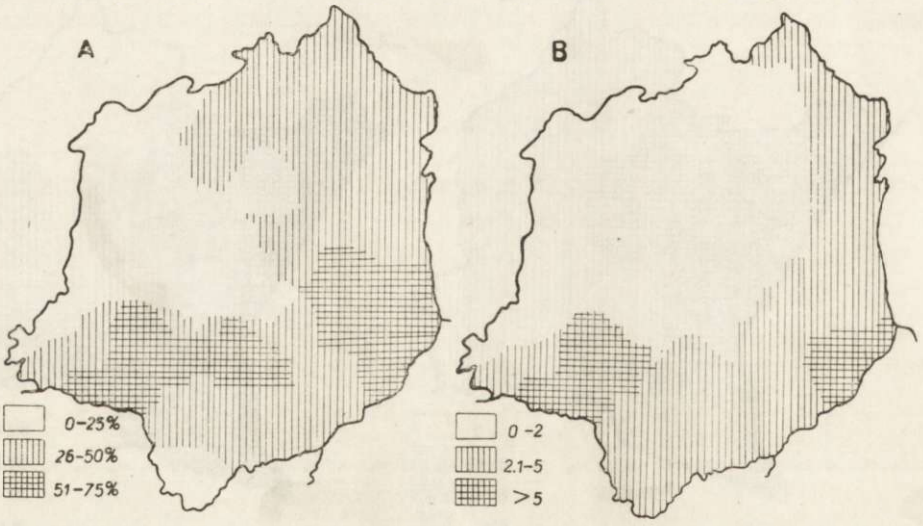

Fig. 2. Plagues of voles and mice in Kielce province.
A — in the period 1945—1957 expressed as per cent of villages affected by mouse plagues; B — in the period 1958—1967 determined as the number of inhabited burrows per 100 sq. m sampling plots.

been divided into three zones showing similar changes in the population of rodents.

(1.1) The north-eastern zone includes mainly lowland terrains bordered from East by the Vistula Valley and from North by Pilica Valley (Fig. 1). In this zone no cyclic appearance of field rodents was recorded, although some local changes could be distinguished in 1946/47, 1956 and 1966. Altogether 35% of villages were affected by vole and mouse plagues.

Particular intensity of appearance of rodents in 1946/47, both in the described area and in other parts of Poland, was the result of war operations in previous years. Hence, in some regions of this zone, rodents caused marked local damage amounting to 20% of crops. In 1956, 13% of villages were affected by rodents. During the appearance of voles in 1966 3 burrows per 100 sq. m were found on the average (Fig. 3—1.1). The common vole constituted the most abundant rodent species in this zone, but migrations of field mice were also observed. Terrains on the bank of the Vistula were usually slightly more abaunding in rodents. On the warp

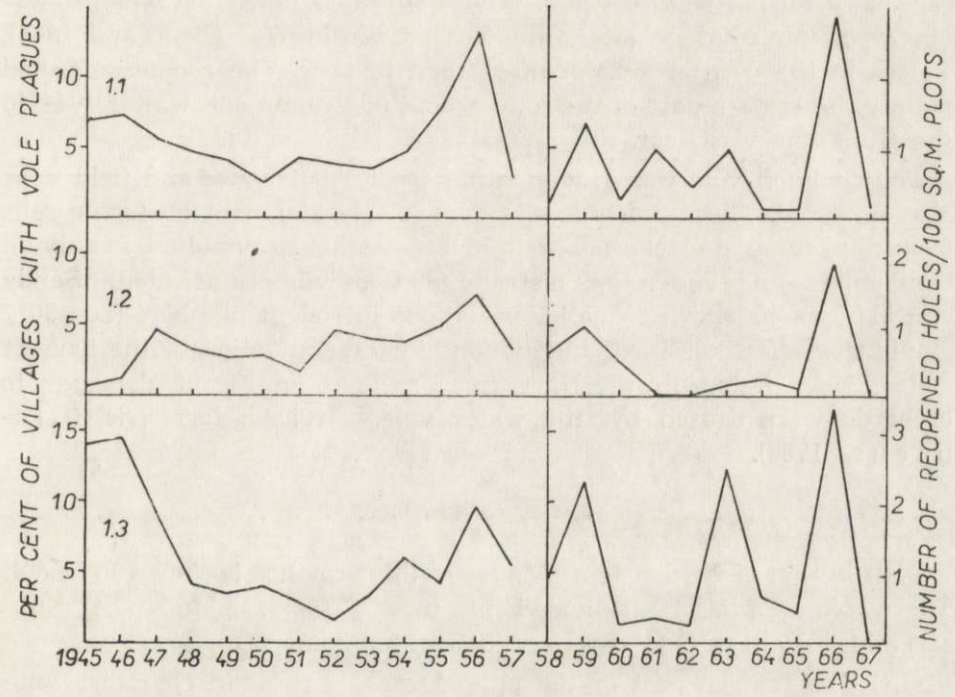

Fig. 3. Fluctuations of vole and mouse numbers in Kielce province during 1945—1957, described as per cent of villages affected by mouse plagues, and during 1958—1967 as number of inhabited burrows per 100 sq. m sampling plots (designation of zones as Fig. 1).

soils of Vistula and Pilica Valleys an increase in the population of the harvest mouse was observed in 1951 and 1954. During 1959 and 1964 also, a higher number of hamsters, *Cricetus cricetus* (L i n n a e u s, 1758), was noted on meadows and waste lands.

(1.2) The western zone includes areas of uplands covered by large forest complexes (Pilica Primeval Forest). In this zone rodents appeared sporadically in numbers not threatening to crops. The outbreaks in

1945—57 affected altogether 20% of villages. A slight increase in populations of voles and mice occurred in 1956 (7% of villages) and 1966 (1.5 burrow per 100 sq. m) (Fig. 3—1.2). An increased number of rodents due to local causes was also noted in 1947, 1952 and 1959. The common vole and field mouse were dominant species.

(1.3) The southern zone lies in the range of uplands and only its south-eastern outskirts reach the Vistula Valley. The mass appearance of rodents was noted in 45% of villages. More pronounced outbreaks occurred in 1945/46, 1956, 1959, 1963 and 1966, and less heavy in 1947, 1950 and 1954 (Fig. 3—1.3). Thus in this zone the plagues show cyclic character, especially during last 10 years. The highest number of rodents was observed immediately after the Second World War (1945 and 1946). Losses in the corn crops amounted then to 20%. The rodents affected mainly the eastern part of the zone, where in autumn and winter 1944/45 the front line was kept.

The common vole was a dominating species but house and field mice also appeared. These rodents were particularly abundant on fertile soils (rendzina, loess, and chernozem of loess origin), acaumulted mainly in Sandomierz and Jędrzejów districts (60% of villages affected). Sandy and loamy soils showed smaller variations in rodent numbers (20—30% of villages affected). Some fluctuations in the population of the harvest mouse were noted in the Nida river valley. Significant damages to orchards were caused by the water vole, *Arvicola terrestris* (Linnaeus, 1758).

2. Kraków Province

Distribution of field rodent plagues in this province is shown in Fig. 4. The whole area has been divided into three regions: uplands (2.4), Subcarpathian Valleys (2.5) and Carpathian Mountains (2.6).

(2.4) The eastern part of the upland zone is rural in character with prevailing loess and humus soils. The western part contains mainly loamy and sandy soils, partially covered by loess. Fluctuations in the number of field rodents were greater on loess and loamy soils (Fig. 5—2.4, broken line) than on sandy soils (Fig. 5—2.5, solid line). Mass appearances of the common vole were usually accompanied by an increased number of field mice. The latter might in some years even exceed the number of voles. A marked rise in the population of field rodents in loess regions was observed in 1946/47, 1951, 1957, 1959 and 1966, and smaller increase on sandy soils in 1950, 1955 and 1960. In some periods the rodent plagues affected approximately 25% of villages (in 1949 and 1957). The density of burrows could reach in some villages 75—100 burrows per 100 sq. m

in autumn 1949. In 1957 the abundance of rodents was already observed in the spring period. The number of active burrows amounted in that time to 25 per 100 sq. m.

(2.5) In the Kraków province mainly the Subcarpathian Valleys were invaded by rodents. In the period 1945—57 63% of villages were affected by the common vole and, to some degree, by the field mouse. Also the harvest mouse, water vole and house mouse were quite numerous. Larger outbreaks of these animals in the western part of the zone were reported in 1951, 1957, 1959 and 1966 (Fig. 5—2.5, broken line), whereas in the eastern part, they occurred in 1946, 1949, 1957 and 1966 (Fig. 5—2.5, solid line). Fluctuations of voles and field mice were not always synchronized. For example, in 1951 a marked reproduction was observed almost exclusively in the population of voles, and in 1957 the field mouse was

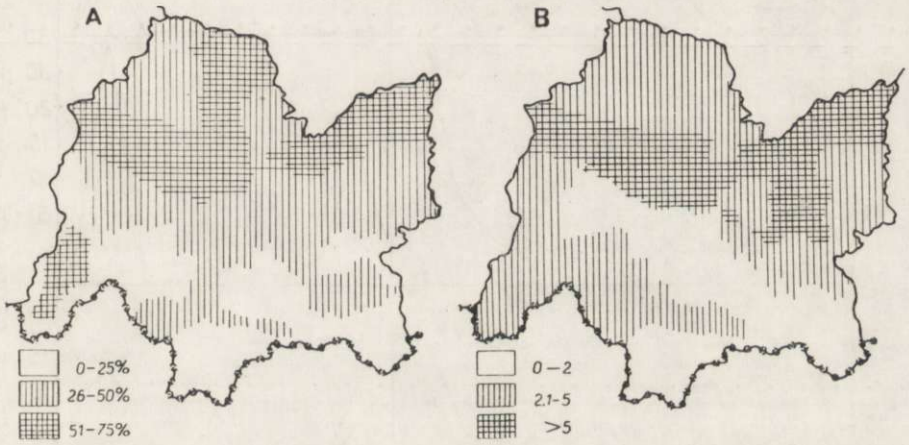

Fig. 4. Plagues of voles and mice in Kraków province.
A — in the period 1945—1957, B — in 1958/1967 (other explanations see Fig. 2).

a dominant species. In 1966 an abrupt increase affected both field mice and voles: 35 to 50 inhabited burrows per 100 sq. m of fields were found in autumn of this year. During »mouse years« the rodents inflicted severe damages to crops. In the Oświęcim district, rodents destroyed crops on the area of approximately 50,000 ha during 1946/47. An increased number of harvest mice was observed mainly in the Vistula Valley. In 1946, 1951, 1954, 1956 and 1960 a similar rise was noted in the population of the water vole, mainly in the western part of this zone.

(2.6) The zone of Carpathian Mountains includes four geographical units: Pogórze (foothill), Beskids, Podhale (valleys) and Tatras. During the last few decades Beskid and Tatra ranges were free of vole and mouse

plagues (G r o d z i ń s k i, 1959). This area is characterized by abundance of rain- and snowfalls, large areas of forests, stony soils and a high degree of fields partition. Small and local increases in the population of voles were found in this region only in 10—16% of villages jointly in 1946, 1949, 1957, 1959 and 1966/67 (Fig. 5—2.6, broken line).

In Pogórze outbreaks of rodents were more pronounced, especially in the northern, loess region. Voles constituted a dominant species but they were usually accompanied by field mice and long-tailed field mice, *Apodemus sylvaticus* (L i n n a e u s, 1758).

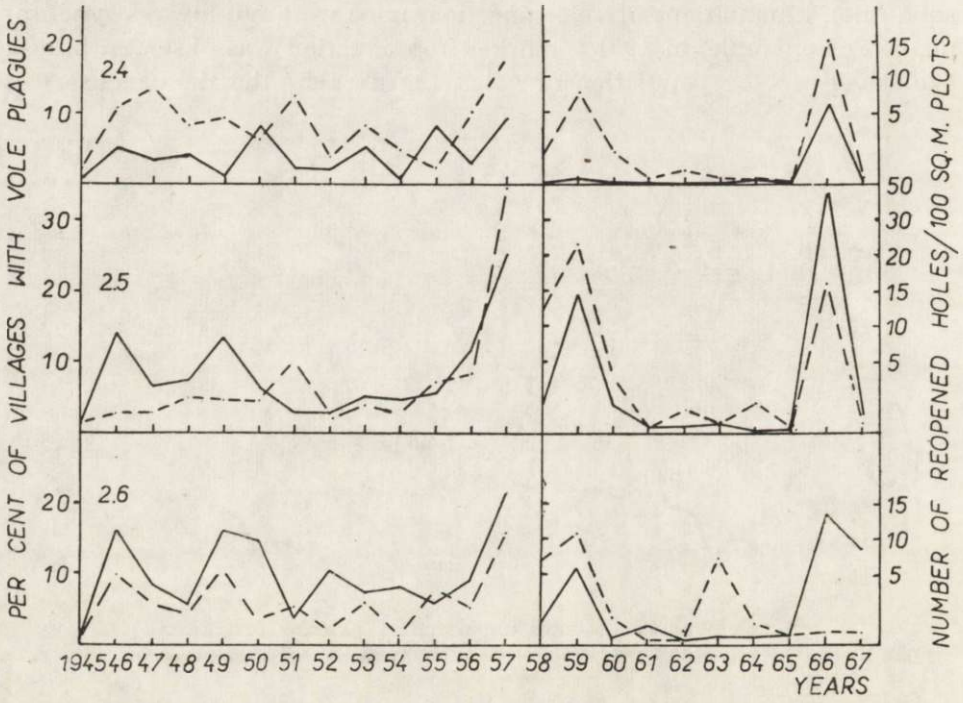

Fig. 5. Fluctuations of field rodent numbers in Kraków province (designation of zones as in Fig. 1, explanations as in Fig. 3).
2.4 — areas of sandy soils (solid line), and areas of loamy and loess soils (broken line). 2.5 — eastern part of the zone (solid line), western part of the zone (broken line). 2.6 — Subcarpathian Valleys (solid line), remaining parts of the zone (broken line).

A separate position is occupied by broad Carpathian valleys, in Podhale (Orawsko-Nowotarska and Spiska Valleys) and in Beskids (Żywiecka, Sądecka Valleys), where larger areas of fields are favourable for spreading of rodents. A marked increase in the population of voles occurred there in 1946, 1949/50, 1952, 1957, 1959, 1963 and 1967/68 (Fig. 5—2.6, solid line). The largest outbreak was observed in 1949 in Sądecka

and Zywiecka Valleys: 50 to 125 active burrows were then found per 100 sq. m. Despite mild winter in 1949/50 vole populations were drastically reduced in both valleys. In summer and autumn 1950 a »delayed outbreak« of these rodents was observed in the Nowotarska Valley and in Spisz. In the Sądecka Valley apparent quantitative fluctuations concerned also the water vole. This species increased in number in 1945, 1951, 1954 and 1957 causing significant damages in orchards and root crops.

3. Rzeszów Province

Mass appearances of rodents in this province during the discussed period are depicted in Fig. 6. These outbreaks manifested themselves in

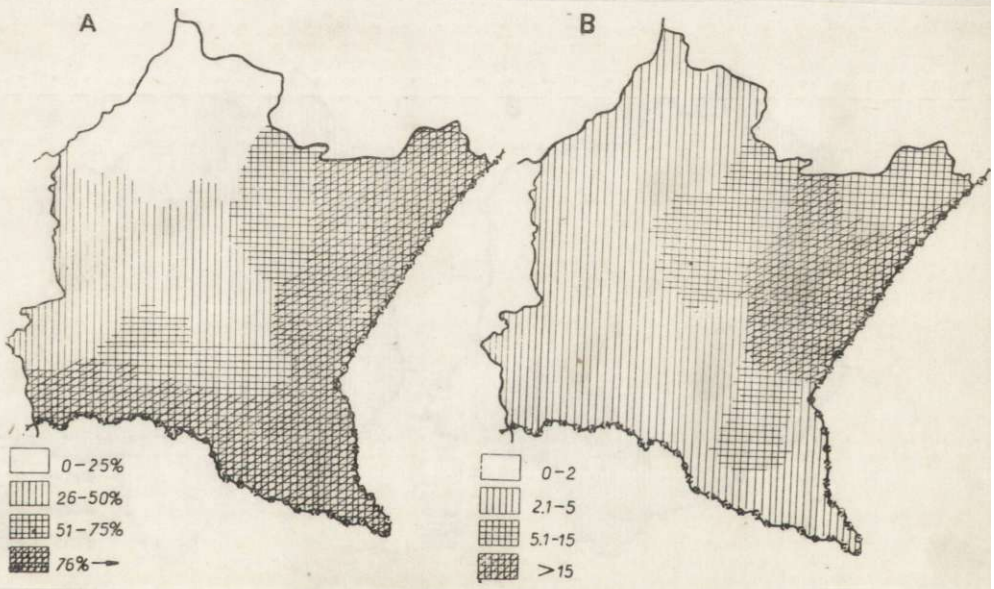

Fig. 6. Mass appearances of voles and mice in Rzeszów province.
A — in the period 1945—1957, B — in 1958—1967 (designations as in Fig. 2).

variable manner in four zones of this province. Heavy plagues occurred in the eastern part of Sandomierz Valley (3.8) and in the southern part of Carpathian Mountains (3.10).

Smaller outbreaks were observed in the central and western parts of this province (3.9). Only the northern part (3.7) was not affected by the appearance of rodents.

(3.7) The northern zone includes part of the Sandomierz Valley with light, sandy soils and large forest areas (Sandomierz Primeval Forest). There are no indications that voles and mice were ever common in this

region. The inquiry data indicate that the largest outbreak of rodents, which occurred in 1946, affected barely 12% of villages. In other years appearances of rodents were only local and observed in less than 10% of villages (Fig. 7—3.7). The increase in the population of voles observed everywhere in 1966 appeared also in this zone but with lower intensity (12 active burrows per 100 sq. m on the average).

(3.8) The most heavy and widespread plagues of rodents (especially of the common vole) occurred in the eastern part of Sandomierz Valley. In 1945—1957 the effects of an abrupt increase in the rodent population were observed in all villages. Consecutive »mouse years«, 1947, 1949, 1953 and 1957, simultaneously affected 20—41% of villages. The mass appea-

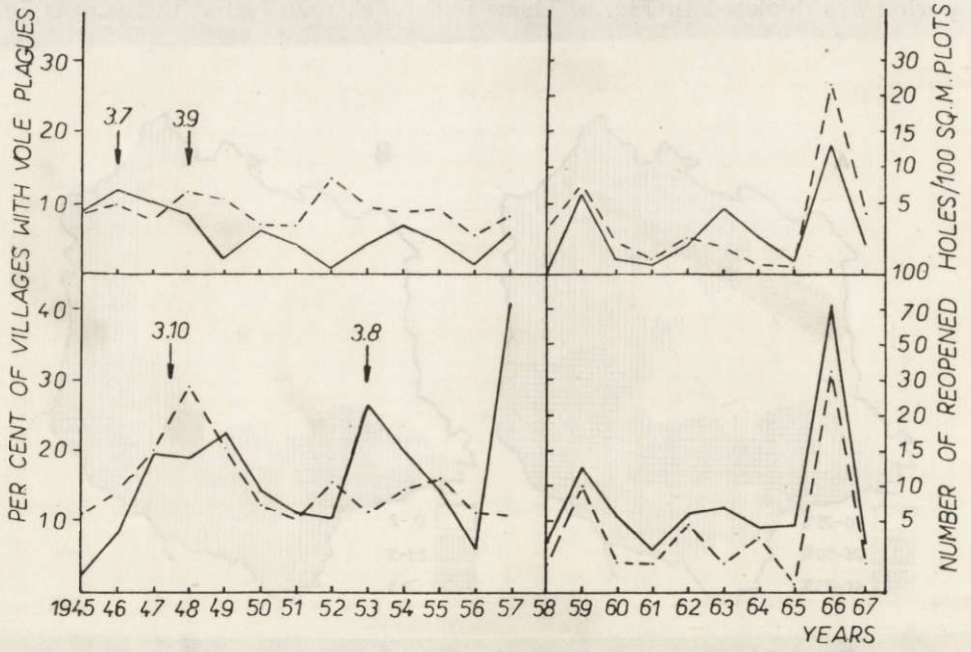

Fig. 7. Vole and mouse plagues on the area of Rzeszów province (designation of zones as in Fig. 1).

rance of voles was also recorded in 1959 (12.5 active burrows per 100 sq. m on the average), and in 1966 (the number of active burrows on 100 sq. m exceeded 70) (Fig. 7—3.8).

The common occurrence and intensity of rodent outbreaks in this zone was caused by war operations in 1944, and by their effects. In subsequent years large areas of fields were abandoned and became the best habitat for voles. In favourable conditions the rodents could then spread to the neighbouring arable grounds. Losses caused by rodents in the years of mass appearance were estimated as 10—30% of crops.

Besides the common vole dominating in outbreaks, some fluctuations were also visible in the number of house and field mice, water voles (1958), hamsters (1959, 1963), and harvest mice in the San and Wisłok Valleys (in 1948/49, 1952 and 1957).

(3.9) Mass appearances of rodents in the western zone covering many upland areas with »mosaic« distribution of fields and forests were certainly less pronounced and less common. Although outbreaks of voles and mice were observed in half of villages, simultaneous appearances in one year did not affect more than 12—15% of villages. The plagues recurred periodically, every 3—5 years, and were particularly visible in 1945/46, 1948, 1952, 1955, 1959, 1962 and 1966 (Fig. 7—3.9). The first outbreak occurred in the area devastated by war operations where the front line persisted for several months (between August 1944 and January 1945), and majority of 1944 crops were not harvested.

The field mouse did not play any significant role in these outbreaks, except in 1955. An increased number of harvest mice was found in 1948/49 (Wisła and Wisłok Valleys), and of water voles in 1948/49 (Skuratowicz, 1957; 1963), and in 1959.

(3.10) The Carpathian zone includes mountainous regions with abundance of forests, stony soils and fields concentrated mainly in broad valleys. From the geographic point of view the zone is divided into the Low Beskid, Bieszczady and Jasielsko-Sanocki Basin.

The area of Low Beskid was affected in 1947—49 by a single, heavy mass appearance of rodents, observed in most villages in isolated valleys. A similar one and strong outbreak of voles and mice occurred in 90% of villages in the eastern part of Polish Bieszczady in 1952—54. In both cases rodent plagues were caused by temporary interruption of field cultivation due to displacement of population. Two years after ceasing of farming, the outbreaks of rodents appeared in the Low Beskid (around 1949), and in Bieszczady (around 1953) (Grodziński, 1957). During trapping on abandoned fields in Bieszczady in the first year of the plague (1952), the trap success amounted to 30—35%. Two years later (autumn 1954) up to 150 burrows per 100 sq. m were observed on this area. A similar density of rodents was found during inspections in the Low Beskid. In 1952—1956, after bringing the land back into cultivation, rodent plagues recurred locally with variable intensity. Slightly larger fluctuations in the number of rodents were also observed in the north-western part of this zone in 1959 and 1966 (Fig. 7—3.10).

Mouse plagues in Carpathians were caused mainly by voles, and only in a small degree by the field mouse. In 1948/49 the water vole was more abundant than usually (Skuratowicz, 1957), whereas the pine vole, *Pitymys subterraneus* (de Sélys-Longchamps, 1835), and the long

tailed field mouse appeared periodically in larger numbers in newly afforested waste lands. Damages to nursery-gardens and forest cultivation caused by the field vole, *Microtus agrestis* (Linnaeus, 1761), were reported to occur in 1959 (Capecki & Gabryel, 1961).

The effects of the first mass appearances of rodents in the discussed zone cannot be treated as simple economical losses since these terrains were then largely depopulated and most fields abandoned. But later, during restoration of normal agricultural economy, local damages to crops, especially to winter grains, caused by rodents amounted to 50—60% of crops.

IV. DISCUSSION

1. Zones Exposed to the Danger of Rodents Outbreaks

In South-Eastern Poland three types of areas may be distinguished in respect of rodent plagues:

(a) mass appearances of rodents occurred chronically in 3—4-year cycles, (b) marked changes in the rodent population had local reasons and were observed once, (c) only slight and sporadic fluctuations in the number of rodents were reported.

Such regions may be demarcated in the Rzeszów province if the »history of mouse years« during the present century is reconstructed (Fig. 8). Chronic outbreaks of rodents took always place in the north-eastern part of this province (zone 3.8). Single and local plagues occurred after the World War II in Carpathians (Low Beskid, Western Bieszczady — zone 3.10). On the other hand, the most northern part of the province (zone 3.7) remained almost free of rodent outbreaks.

An accurate estimation of zones permanently exposed to the danger of rodent plagues is very important for plant protection. In the Rzeszów province the districts of Przeworsk, Jarosław, Lubaczów, nad majority of Przemyśl district (3.8), certainly belong to such zone. In the Kielce province such terrains occupy smaller areas and include districts of Jędrzejów and Sandomierz (zone 1.3). In the Kraków province only the districts of Subcarpathian Valleys (Oświęcim, Kraków, partly Chrzanów, Bochnia, Brzesko, Tarnów, Dąbrowa Tarnowska — zone 2.5) are to some degree exposed to rodent outbreaks. The foregoing zones do not show an identical danger of rodent plagues. The most heavy appearances took always place in the Rzeszów province and much weaker in the two remaining provinces.

Local outbreaks could be no less severe than chronic, but usually they occurred only once. Such appearances took place on terrains devastated by war operations (1945—46, *e.g.* zone 3.9), as well as in the Low Beskid

and Western Bieszczady (1947/49 and 1952/54; zone 3.10). In all these cases an abrupt increase of the rodent numbers was connected with disturbances of field economy. In areas adjacent to the front line the harvest was often impossible (Simm & Skuratowicz, 1950). On the other hand, during the displacement of the population in the area of Carpathian Mountains many fields lay fallow for some years (Grodziński, 1957). With the lack of any agricultural operations, the rodents

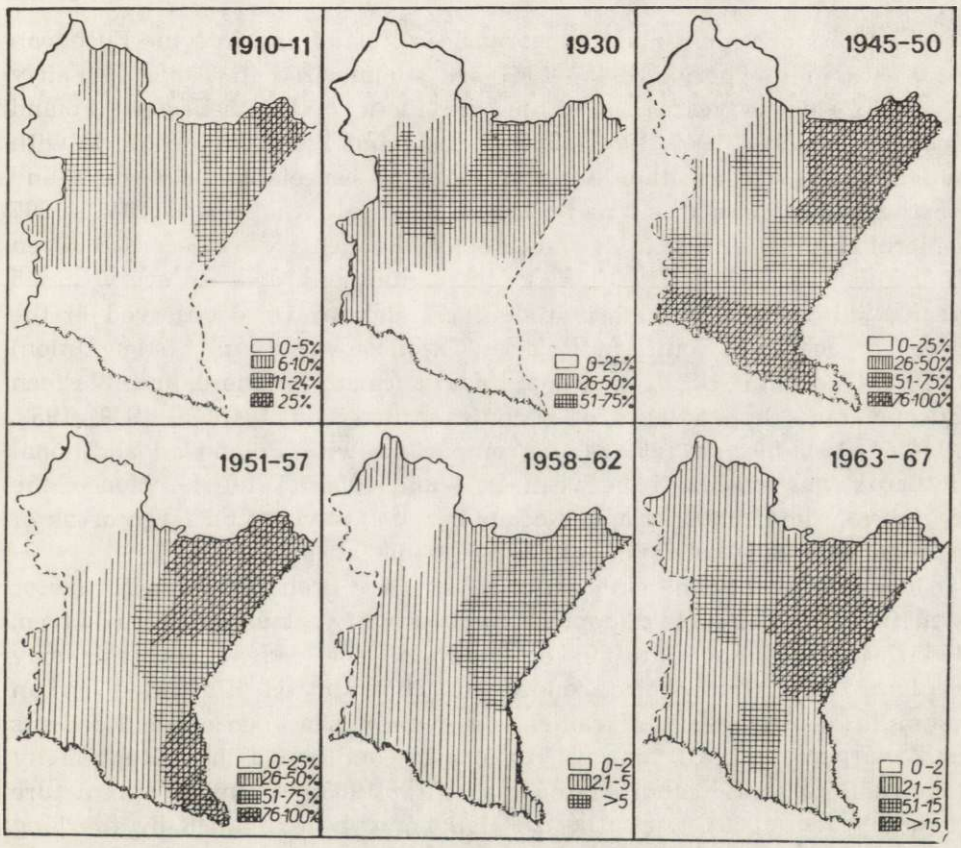

Fig. 8. History of vole and mouse plagues in central and eastern parts of Rzeszów province in the present century. On the map drawn for the period 1910—1957 percentage of affected villages is given, whereas for the period 1958—1967 the mean number of inhabited burrows per 100 sq. m plots is estimated. The first two maps (1910 and 1930) after Kuntze & Szynal (1934), modified.

had abundant of food and undisturbed life conditions. Usually in two or three years after recultivation of the land the rodent outbreaks gradually disappeared.

Chronic vole and mouse plagues are probably favoured by fertile soils, such as loess, rendzina or chernozem of loess origin, as well as by

scarcity of forests (zones 1.3, 2.5, 3.8). Sandy and mountainous soils and some podzols (*e.g.* zones 1.2, 2.4, 2.6, 3.7 and 3.10) provide unfavourable conditions. Mass appearances of rodents are also prevented by large forest complexes and mountainous terrains (zones 1.1, 1.2, 2.6 and 3.10). However, even in such unfavourable geographical environments, rodent plagues may occur if the field economy is drastically disturbed (zone 3.10).

2. Cyclic Occurrence of Plagues

The years of rodent mass appearance in Poland and in some European countries in the period 1945—1967 are summarized in Table 1. Fairly common »mouse years« in three provinces of South-Eastern Poland occurred in 1946, 1949, 1952, 1956/57, 1963 and 1966. They coincide with rodent outbreaks in other parts of Poland, especially in western and northern provinces (Skuratowicz, 1957). In the period 1945—1967 general fluctuations in the number of field rodents were recorded seven times on these areas. The highest rodent numbers recurred every 3 or 5 years. Similar fluctuations in rodent populations were observed in the areas adjacent to Southern Poland (Czechoslovakia and Soviet Union) (Table 1). In the USSR and some countries of Northern and Western Europe, mass appearances of rodents occurred in 1945/46, 1949, 1952, 1954/55, 1958/59 and 1963/64. In comparison with Poland an additional outbreak was observed between 1954 and 1956 (Table 1). Hence the cyclic vole and mouse plagues occur every few years on large areas of Europe although their synchronization is not always clear.

On smaller areas the climatic conditions are probably the main factor synchronizing the cycle of population density of various rodents (Elton, 1965). One-year accelaration or delay of the rodent outbreak may explained by atmospheric conditions. This fact is illustrated on an example of Poland and Ukraine. The mass appearance of field rodents in Zakarpacie and Ukraine in 1954 was conditioned by exceptionally favourable climatic conditions (Gruzdev, 1963). A similar »premature mouse year« (1959) in Southern Poland may be explained by the long and warm autumn, abundance of snow cover in winter, and very early and warm spring. This mass appearance, however, promptly declined during the very dry summer (Skuratowicz & Czarnecki, 1960).

3. Estimation of Damages Caused by Vole Plagues

Losses caused by field rodents in years of mass appearance are usually estimated as percentage of cultivated area, or mass of the destroyed crop. If the density of rodents, or their burrows are estimated by an independent method, then the potential losses may easily be calculated from the balance of energy flow. In such a balance both the consumption of

Table 1.

Fluctuations of field rodent numbers in South-Eastern Poland (Kielce, Kraków and Rzeszów provinces), on the adjacent areas, and in some European countries.
Crosses indicate the years of rodent plagues.

Region, country	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	Reference
Kielce — province	+	+										+			+				+			+		This study
Kraków — province		+	+		+		+						+		+							+		This study
Rzeszów — province		+	+	+	+			+	+				+		+				+			+		Skuratowicz, 1957; 1963
Poland		+			+			+			+													
Czechoslovakia		+			+			+			+	+	+											Grulich, 1959;
USSR, Western Ukraine										+	+		+				+		+					Mošansky, pers. comm.
USSR, Zakarpacie	+					+				+														Rudišin, 1958;
USSR, Smoleńsk — province									+			+		+										Gruzdev, 1957—1965; 1957
USSR, Tula — province	+			+			+			+		+												Turjanin, 1957; 1958
Finland										+				+				+	+					Kuz'mina, 1960
Netherlands		+		+	+			+			+	+												Maksimov, 1964
Western France					+			+			+				+					+				Myllymäki, 1967
Eastern France					+			+		+			+							+	+			Wijngaarden, 1957
																								Dixmeras, 1967
																								Harrenger, 1967

the rodent population and the primary net productivity of cultivated plants are expressed in terms of energy units (kcal).

An attempt of such estimation will be given for the population of the common vole (*M. arvalis*), which is the dominating species in all rodent outbreaks. The bioenergetics of the common vole is well known: the costs of maintenance (Grodziński, 1966; Trojan & Wojciechowska, 1967a), costs of reproduction (Trojan & Wojciechowska, 1967b; Migula, 1969), daily energy budgets (*DEB*) (Trojan & Wojciechowska, 1969), as well as food consumption and assimilation (Drożdż, 1968), have been determined. The daily costs of maintenance (*DEB*) of a 20 g vole obtained from Tables by Trojan & Wojciechowska (1969) amount to 10.04 kcal/animal, when they are adapted to the given mean annual thermic conditions. The daily assimilation of such vole will amount to 10.4 kcal/animal since in the *Microtus* population additional 3% of costs of maintenance are required

Table 2.

Annual consumption by vole populations with different density.

Vole density No/ha	Yearly vole consumption, 10^3 kcal/ha	Equivalent of consumed crop (in kg)			
		Alfaalfa hay[1])	Clover hay[2])	Timothy hay[3])	Rye[4])
5	22.8	7	6	6	6
80	365.0	106	96	95	96
1,000	4,562.5	1,323	1,200	1,186	1,200

The following caloric values of 1 g weight were assumed: [1]) 3.49, [2]) 3.80, [3]) 3.84, [4]) 3.80, as based on the data after Golley (1960), Maynard & Loosli (1962), Herbichowa (1969) for dry weight, and correcting for 11—15% of water contens.

for production (Golley, 1960). The coefficient of assimilation in *M. arvalis* is equal to 86.2% on the average (Drożdż, 1968; Migula, 1969). Hence the food consumption is higher than assimilation by 1.21 and for a 20 g vole it amounts to 12.5 kcal/day. The annual consumption of the vole population with three exemplary densities is reported in Table 2: at a low density (5 animals per ha), at the average density (80 animals/ha), and at disastrous density (1000 animals/ha). With such different densities the voles should consume from 23 thousand to over 4.5 million kcal/ha per year. The amount of consumed calories can be expressed by mass of alfaalfa hay, clover hay, timothy hay, or rye. The caloric value of these crops is similar and ranges from 4.1 to 4.5 kcal/g (Golley, 1960; Maynard & Loosli, 1962; Herbichowa, 1969). On the other hand, the caloric value of commercial crops (11—15% of water) is equal to 3.5—3.8 kcal/g. Hence a little less than 1000 kcal

constitutes the equivalent of 250 g of these products. With the low population density the voles consume less than 10 kg per year per 1 ha, but at disastrous density this figure markedly exceeds 1000 kg/ha per year (Table 2). Finally the consumption of a vole population should be related to the total primary production of cultivated plants. With the density of 5 voles per 1 ha the animals can consume less than 1% of plant production, but with density of 1000 specimens/ha — over 20% of the whole vegetation.

A similar method of loss estimation was already attempted by Spitz (1968) and by Trojan (1968). Although this method is very accurate, it has at least two weak points: (1) by determining the amount of plant material consumed by voles it is impossible to estimate the total vegetation destroyed, (2) total primary production, especially of grain exceeds the crop harvested by man.

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POJAWY POLNIKÓW I MYSZY W POLSCE POŁUDNIOWO-WSCHODNIEJ W LATACH 1945—1967

Streszczenie

Celem pracy było wyznaczenie w południowo-wschodniej Polsce obszarów, na których pojawy polników i myszy wyrządzają istotne szkody gospodarcze oraz przedstawienie fluktuacji ilościowych tych gryzoni w okresie 23 powojennych lat (1945—1967). Badaniami objęto trzy województwa (kieleckie, krakowskie, rzeszowskie = 53.505 km²), których wspólną cechą jest górzystość i związany z tym charakter gospodarki rolnej. Materiały do pracy pochodzą z trzech źródeł: (1) własnych badań i ekspertyz terenowych, prowadzonych głównie w latach 1954—1957 i 1966—1967, (2) danych ankietowych z lat 1957—1958 oraz (3) informacji udostępnionych przez Stacje Kwarantanny i Ochrony Roślin, dotyczących szczególnie lat 1958—1967. W oparciu o te dane, obszar badanych województw podzielono na 10 stref, z których każda zawiera po kilka powiatów o zbliżonym zagęszczeniu gryzoni (1.1 — 1.3, 2.4 — 2.6, 3.7 — 3.10) (Ryc. 1).

Masowe pojawy gryzoni (tzw. „lata mysie") są powodowane głównie przez wzrost populacji polnika zwyczajnego (*Microtus arvalis*), a w znacznie mniejszym stopniu myszy polnej (*Apodemus agrarius*). Podrzędną rolę w takich pojawach może lokalnie odgrywać również badylarka (*Micromys minutus*), mysz domowa (*Mus musculus*) i karczownik (*Arvicola terrestris*).

Występowanie pojawów gryzoni w poszczególnych województwach przedstawiono sumarycznie na mapach (Ryc. 2, 4, 6), natomiast wahania liczebności w badanym okresie w różnych strefach ilustrują wykresy (Ryc. 3, 5, 7). Dane odnoszące się do lat 1945—1957 wyrażone zostały procentem wsi dotkniętych wyraźnym pojawem gryzoni (Ryc. 2A, 4A, 6A), podczas gdy w latach 1958—1967 zagęszczenie gryzoni przedstawiono liczbą czynnych nor, przypadających na powierzchnię 100 m² (Ryc. 2B, 4B, 6B). Te same kryteria użyte zostały przy określaniu fluktuacji ilościowych

gryzoni (Ryc. 3, 5, 7). Posługując się różnymi źródłami odtworzono również historię pojawów gryzoni na terenie województwa rzeszowskiego w bieżącym stuleciu (1910—1967) (Ryc. 8).

Intensywność pojawów gryzoni jest związana z takimi czynnikami jak rzeźba terenu, rodzaj gleb i stopień zalesienia. Żyzne gleby i małe zalesienie stwarzają korzystne warunki dla powstawania plag gryzoni (strefy: 1.3, 2.5, 3.8), natomiast gleby piaszczyste i górskie (np. strefy: 1.2, 2.4, 2.6, 3.7, 3.10) jak też duże kompleksy leśne i górzystość terenu (strefy: 1.1, 1.2, 2.6, 3.10) znacznie przed nimi zabezpieczają. Plagi gryzoni mogą jednak opanowywać obszary o niesprzyjających warunkach geograficznych, jeśli drastycznie będzie zaburzona tam ciągłość gospodarki rolnej (strefa 3.10).

Na terenie Polski południowo-wschodniej można wyróżnić trzy typy obszarów, różniące się w omawianym okresie stopniem zagrożenia przez gryzonie polne. Pierwszy z nich charakteryzuje chroniczność pojawów w cyklu 3—5 letnim. Obejmuje on przede wszystkim powiaty Jarosław, Lubaczów, Przeworsk i większość przemyskiego w woj. rzeszowskim (strefa 3.8), a w mniejszym stopniu także powiaty Jędrzejów i Sandomierz w woj. kieleckim (strefa 1.3) oraz Oświęcim, Kraków i częściowo Bochnia, Brzesko, Chrzanów, Dąbrowa Tarnowska i Tarnów w woj. krakowskim (strefa 2.5).

Obszary dotknięte działaniami wojennymi (lata 1944—1946, strefa 3.9) oraz Beskid Niski i Bieszczady Zachodnie (strefa 3.10), gdzie w latach 1947—1949 i 1952—1954 zaburzona została gospodarka rolna, reprezentują typ drugi, dotknięty okresowymi i lokalnymi tylko pojawami gryzoni. Typ trzeci stanowią pozostałe tereny badanych województw, na których gryzonie polne występują mniej licznie.

Powszechniejsze pojawy gryzoni w Polsce południowo-wschodniej miały miejsce w latach 1946, 1949, 1952, 1956/57, 1959, 1963, 1966 i zwykle były one zsynchronizowane z podobnymi pojawami w innych częściach Polski oraz w sąsiednich krajach europejskich (Tabela 1). Rozbieżności wyrażające się przyspieszeniem bądź opóźnieniem o jeden rok masowego pojawu, można zazwyczaj tłumaczyć lokalnymi warunkami atmosferycznymi. „Lata mysie" mają więc charakter cykliczny na wielkich obszarach.

Posługując się metodą bilansu energetycznego oceniono straty powodowane w uprawach przez polnika zwyczajnego, przy różnym zagęszczeniu jego populacji. Dobowe koszty utrzymania (DEB) 20-gramowego polnika wynoszą około 10,0 kcal/osobnika, a jego konsumpcja odpowiada 12,5 kcal/osobnika. Roczna konsumpcja populacji polników o przykładowym zagęszczeniu niskim, średnim i klęskowym (5, 80 i 1000 osobników/ha) zamyka się w granicach od 23 tysięcy do 4,5 milionów kcal/ha na rok. Ekwiwalent 1000 kcal stanowi w przybliżeniu $^1/_4$ kg siana z lucerny, koniczyny, trawy lub też zboża. Populacja polników o niskim zagęszczeniu zjada więc mniej niż 10 kg tych plonów rocznie na 1 ha, natomiast przy zagęszczeniu klęskowym aż 1200—1300 kg/ha na rok (Tabela 2). Stanowi to ułamek 1% i przeszło 20% całkowitej produkcji pierwotnej (roślinnej) uprawy. Opisana metoda jest bardzo dokładna, jednak określając ilość roślinności zjedzonej przez gryzonie nie można ocenić całości zniszczonej przez nie wegetacji.