

## **HABITAT SELECTION OF WILD BOAR (*SUS SCROFA*) IN THE ZIELONKA GAME INVESTIGATORY CENTRE – RADIO TELEMETRY RESEARCH**

Grzegorz Górecki, Lesław Łabudzki, Jacek Skubis,  
Marian Wlazełko

Poznań University of Life Sciences

**Abstract.** The research concerned the behaviour of a wild boar population in a large (7,500 ha) contiguous forest complex. The results obtained through telemetry include the size of home ranges, daily home ranges, and movement rates of the individuals observed. The separation of female and male home ranges was revealed. The researchers established that the wild boars were most often to be found in Scots pine stands in fresh mixed broad-leaved forest habitats.

**Key words:** wild boar, habitat selection, radiotelemetry, capturing, immobilization

### **INTRODUCTION**

Research grant “Wild boar (*Sus scrofa* L.) behaviour in a large forest complex” was carried out in 2003-2007 in the Department of Game Management, August Cieszkowski Agricultural University, Poznań – currently the Department of Game Management and Forest Protection, Poznań University of Life Sciences.

One of the research issues was to analyse the habitat use on the basis of the data collected by means of telemetry.

### **MATERIAL AND METHODS**

The research was conducted in the Zielonka Game Investigatory Centre, Department of Game Management and Forest Protection, Poznań University of Life Sciences (Zielonka GIC). Zielonka GIC’s total area is 13,000 ha, with forest area located in the

Zielonka Experimental Forest District<sup>1</sup> and Łopuchówko Forest District<sup>2</sup>. They form a contiguous forest complex with an area of ca. 7,500 ha, about 35 km north-east of Poznań.

Zielonka GIC's area is highly diverse in terms of morphology. Its topographic profile is flat, wavy in places with many outwash plains, end moraine hills and postglacial channel lakes [Rutkowski 2002]. The average annual temperature is 8.2°C and the average temperature during the vegetation season (31 March-5 November) is 14.7°C. The precipitation amounts to ca. 550 mm.

Zielonka GIC's forests comprise pine-oak stands in fresh mixed broadleaved forest (72%), fresh broadleaved forest (6%), and fresh mixed coniferous forest (20%) habitats. Scots pine dominates in ca. 75%, and oak in ca. 13% of stands. The actual proportion of oak is higher as it is present in the undergrowth layer. This structure reflects the past economic approach to forest management, when Scots pine was preferred to be the main forest species.

The research concerned the wild boars captured with traps built according to a design developed at the former Department of Game Management, August Cieszkowski Poznań Agricultural University (Photo 1). In the research period, 43 individuals were captured and marked with a numbered ear tag, with 10 animals (8♀, 2♂) fitted with radio transmitters.



Phot. 1. Catching enclosure in a Scots pine stand (Photo by D. Świątek)  
Fot. 1. Odłownia w drzewostanie sosnowym (fot. D. Świątek)

After an individual was anaesthetized with a mixture of xylazine (*Xylazine hydrochloride* – 5 mg per 1 kg of body weight) and ketamine (*Ketamine hydrochloride* – 8 mg per 1 kg of body weight), a transmitter collar was put on the animal and appropriately adjusted. The transmitter collars were only put on the older individuals (sows

<sup>1</sup> Poznań University of Life Sciences.

<sup>2</sup> State Forests National Forest Holding.

and males aged over 3 years), after anaesthetizing them, and adjusted individually so that the animals would not find it difficult to breathe or swallow, and would not lose or whip off the collar. The transmitter collar is 530 g in weight; according to manufacturer's data, the transmitter battery life is 30 to 60 months.

The optimal way to locate an animal is to perform three readings with an angle changed by 60°, which provides the smallest error polygon [Leptich and Glibert 1989, Samuel and Fuller 1994, Górecki and Kasprzak 2001]. However, in forest area the radio-wave is often diffracted or reflected. This is why the wild boars were also located with two readings, with their angle changed by 90° [Górecki and Kasprzak 2001]. Only the readings performed within 15 minutes from each other were used in the analysis. Subsequent locations were performed after up to one hour after each other. The results were analyzed with 'Tracker', a Swedish software [Instrukcja... 1997].

The following methods were used to calculate the size of home ranges: convex polygon method, core convex polygon method, elliptic range method, harmonic mean method, and kernel method [Dixon and Chapman 1980, Samuel and Fuller 1994, Wor-ton 1989].

## RESULTS

All the observations collected with the aforementioned methods were used to determine the size of the animals' home ranges (Table 1). The largest home ranges were that of male 2 – 415.23 ha – and female 8 – 229.23 ha. The smallest home range was used by male 5 – only 103.71 ha. An average home range of wild boar was 137.90 ha, while the overall area penetrated by all the animals was nearly 690 ha.

Table 1. Home ranges of the observed wild boars and their coefficients of variation (W)

Tabela 1. Życiowe arealy osobnicze obserwowanych dzików oraz ich zmienność (współczynnik zmienności W)

Method Metoda	Maximum Maksimum ha	Average Średnia ha	Minimum Minimum ha	W %
Convex polygon method Metoda poligonów wypukłych	315.19	91.18	4.72	148
Core convex polygon method Metoda zawężonych poligonów	250.18	77.90	4.72	139
Elliptic range method Metoda elipsy	415.23	137.91	13.66	131
Harmonic mean method* Metoda średniej harmoniczej*	439.36	110.76	11.12	168
Kernel method** Metoda jąder aktywności**	444.33	154.02	22.71	126

\*Partial home ranges were present in all cases.

\*\*Only one individual (male 2) featured partial home ranges.

\*We wszystkich przypadkach wystąpiły arealy cząstkowe.

\*\*Arealy cząstkowe tylko w przypadku jednego osobnika – odyniec nr 2.

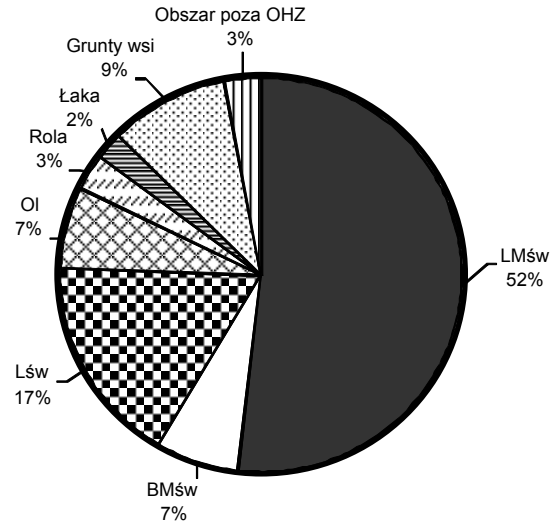


Fig. 1. Wild boar presence in forest and other habitat types: LMśw – fresh mixed broadleaved forest, BMśw – fresh mixed coniferous forest, Lśw – fresh broadleaved forest, Ol – alder forest, Rola – farmland, Łąka – meadow, Grunty wsi – village, Obszar poza OHZ – non-Zielonka GIC area

Rys. 1. Częstość występowania dzików w poszczególnych typach siedliskowych lasu oraz innych biotopach: LMśw – las mieszany świeży, BMśw – bór mieszany świeży, Lśw – las świeży

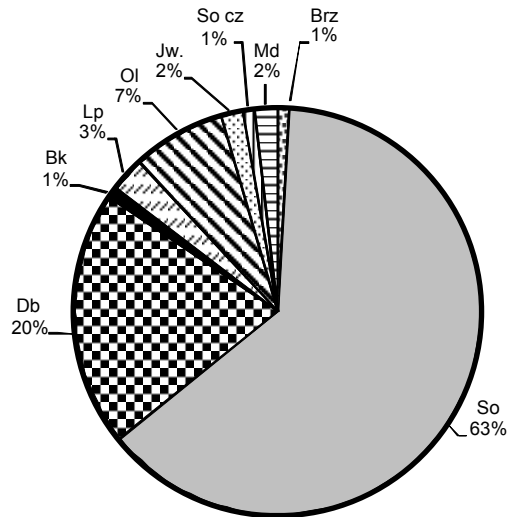


Fig. 2. Wild boar presence in relation to the dominant species in a stand: Brz – birch, So – Scots pine, Db – oak, Bk – beech, Lp – lime, Ol – alder, Jw – great apple, So cz – black pine, Md – larch

Rys. 2. Częstość występowania dzików w zależności od gatunku panującego w drzewostanie: Brz – brzoza, So – sosna, Db – dąb, Bk – buk, Lp – lipa, Ol – olcha, Jw – jawor, So cz – sosna czarna, Md – modrzew

The convex and core convex polygon methods (based on 95% of observations) also confirmed that the largest areas were used by male 2 (315.19 ha) and female 8 (121.27 ha).

The harmonic mean method and kernel method were used to identify partial home ranges, i.e. the areas where individuals were most active. The former assumes no preference of any part of the area as a point of reference; thus, all the individuals observed used partial home ranges. The latter method, which establishes partial home ranges with regard to animals' preference, indicated that male 2 was the only animal that used two partial home ranges (77.78 and 366.55 ha).

Two female home ranges were found to overlap with each other by 80%. The areas used by males overlapped neither with each other, nor with female areas.

The calculated sizes of home ranges featured very high coefficients of variation, from 131% to 168%.

The coefficient of variation with regard to wild boar daily home ranges was 52.15%. The largest daily home range of a female was 82.96 ha (female 1, 13/14.01.2005), the smallest one was 14.46 ha (female 4, 28/29.06.2006). The largest male daily home range was 79.78 ha (male 2, 2/3.11.2005), and the smallest one was 7.18 ha (male 5, 5/6.05.2004). The average daily home range that was used by the wild boars during the research period was 43.79 ha.

During night activity the observed individuals moved at an average rate of 300 m per hour. The researchers also calculated the distances covered by the wild boars. The individuals which were captured and collared moved away from a catching enclosure at a distance of 1,800 to 4,800 m (males) or 2,150 to 2,660 m (females).

The feedback on 33 marked young wild boars showed that nine of them were shot within 4 km, and only one individual at a distance of over 5 km, from a catching enclosure. The radio tagging research provides valuable data on the use of various habitats by the observed individuals, by linking the locations with an inventory description of a stand where the animals were located.

The marked wild boars were located mostly in broadleaved habitats (ca. 75% of observations), mainly the fresh mixed broadleaved forest (52%). As for coniferous forest habitats, only fresh mixed coniferous forest was used – in ca. 7% of locations. Eighteen percent of the observations occurred in non-forest areas: ploughland and meadows (3%), and non-agricultural areas (mainly former fields scheduled for building development).

Figure 1 from all the observed individuals, only male 5 preferred other habitats, as it was located only in the fresh mixed broadleaved forest.

The data collected during locations were used to analyse the forest stands used by the wild boars with respect to the dominant species. The observed individuals were located in 63% of events in Scots pine stands, and in 20% of events in oak stands (Fig. 2). Three of the observed individuals (male 2 and females 3 and 4) lived only in stands with Scots pine as the dominant species.

All the wild boars, except for male 2, showed little interest in forest stands of less than 30 years of age. Most observations were made in stands aged from 30 to 60 years, and in the case of male 2 and females 1 and 8 in stands aged from 80 to 100 years. Male 5 displayed its attachment to a specific area, limiting its area of activity only to forest stands aged from 40 to 60 years in over 75% of events. Only more active females changed their locations more often, and in over 28% of events were found in forest stands aged from 80 to 120 years. Figure 3 shows the rate of wild boar occurrence in forest stands by their age.

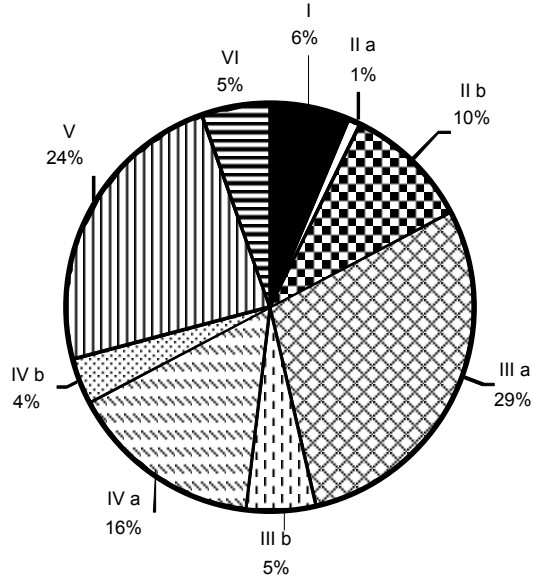


Fig. 3. Wild boar presence in forest stands by their age

Rys. 3. Częstość występowania dzików w drzewostanach różnych klas wieku

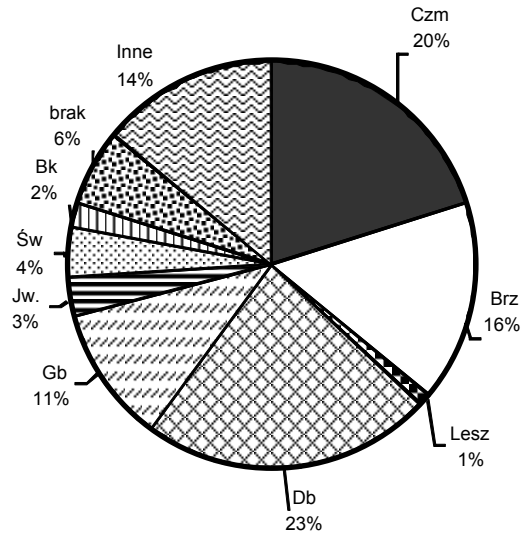


Fig. 4. Undergrowth species in wild boar locations: Czm – bird cherry, Brz – birch, Lesz – hazel, Db – oak, Gb – hornbeam, Jw – great maple, Św – spruce, Bk – beech, Brak – none, Inne – other

Rys. 4. Gatunki podszytowe w miejscach występowania dzików: Czm – czeremcha, Brz – brzoza, Lesz – leszczyna, Db – dąb, Gb – grab, Jw – jawor, Św – świerk, Bk – buk

Undergrowth is considered by the wild boar as an important part of its habitat. The researchers established that only 6% of the locations were in forest stands without the undergrowth. The wild boars were most often found in those parts of forest stands where oak (23%), bird cherry (20%), birch (16%) and hornbeam (11%) formed the undergrowth layer (Fig. 4).

Wild boars were most often found in stands with moderate (54%) and interrupted canopy (39%). Only 7% of locations were in closed or loose canopy stands.

The observed individuals were most often located in parts of forest with a turf (39%) and strong turf (37%). The green soil cover accounted for 8%, and litter for 14% of events (Fig. 5).

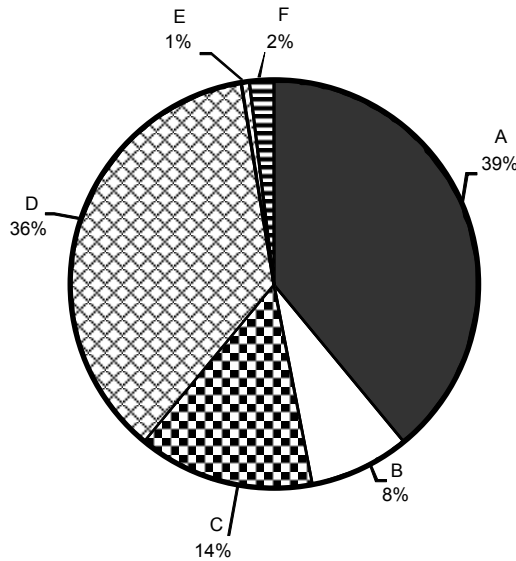


Fig. 5. Wild boar presence by forest soil cover: A – turf, B – green, C – forest litter, D – strong turf, E – dead, F – moss

Rys. 5. Częstość występowania dzików w zależności od rodzaju pokrywy dna lasu: A – zadarniona, B – zielna, C – ściółka, D – silnie zadarniona, E – naga, F – mszysta

The researchers also established the proportion of forest floor plant species in each forest subcompartment where the wild boars occurred (Table 2).

The most common species was reed grass (72.8%), followed by male fern (53.3%), bilberry (39.1%), bracken fern (26.1%), raspberry (25%), blackberry (22.8%), wood sorrel (18.5%) and pleurosium schreberi (16.3%).

Table 2. Forest floor plant species in wild boar locations (names according to Mirek et al. 2002)  
 Tabela 2. Skład runa leśnego w miejscach występowania dzików (nazwy roślin wg Mirek i in. 2002)

Species Gatunek	Percent Udział procentowy
Small reed ( <i>Calamagrostis</i> sp.) Trzcinnik ( <i>Calamagrostis</i> sp.)	72.8
Common male fern ( <i>Dryopteris filix-mas</i> ) Nieczelnica samcza ( <i>Dryopteris filix-mas</i> )	53.3
Bilberry ( <i>Vaccinium myrtillus</i> ) Borówka czarna ( <i>Vaccinium myrtillus</i> )	39.1
Bracken ( <i>Pteridium aquilinum</i> ) Orlica pospolita ( <i>Pteridium aquilinum</i> )	26.1
Wild raspberry ( <i>Rubus idaeus</i> ) Malina właściwa ( <i>Rubus idaeus</i> )	25.0
Blackberry ( <i>Rubus plicatus</i> ) Jeżyna fałdowana ( <i>Rubus plicatus</i> )	22.8
Wood sorrel ( <i>Oxosalis acetosella</i> ) Szczawik zajęczy ( <i>Oxosalis acetosella</i> )	18.5
<i>Pleurosium schreberi</i> Rokietnik zwyczajny ( <i>Pleurosium schreberi</i> )	16.3
Fescue ( <i>Festuca</i> sp.) Kostrzewa ( <i>Festuca</i> sp.)	12.0
Sedge ( <i>Carex</i> sp.) Turzyca ( <i>Carex</i> sp.)	12.0
Hair grass ( <i>Deschampsia</i> sp.) Śmiałek ( <i>Deschampsia</i> sp.)	12.0
Rush ( <i>Juncus</i> sp.) Sit ( <i>Juncus</i> sp.)	12.0
Nettle ( <i>Urtica</i> sp.) Pokrzywa ( <i>Urtica</i> sp.)	9.8
Wood rush ( <i>Luzula</i> sp.) Kosmatka ( <i>Luzula</i> sp.)	7.6
Lily of the valley ( <i>Convallaria majalis</i> ) Konwalia majowa ( <i>Convallaria majalis</i> )	6.5
Grasses ( <i>Poaceae</i> ) Trawy ( <i>Poaceae</i> )	6.5

## SUMMARY OF RESULTS

The experiences gained during the research indicated the need to develop a different solution for fitting wild boar with radio transmitters. Due to wild boar's anatomy, the conventional collars failed to serve their purpose. Wild boar's specific build, which requires the collar to be tightly adjusted, poses the risk of throttling full-grown individuals. Male 2 (ear tag 15), captured for the first time 23 November 2004 (Photo 2), lost its collar which was found 14 January 2005. The individual was then recaptured





Phot. 2. Needle bent during an injection (Photo by D. Świątek)  
Fot. 2. Igła skrzywiona podczas iniekcji (fot. D. Świątek)



Phot. 3. Collared male 2  
Fot. 3. Odyniec 2 po zaobrożnaniu

(at the same catching enclosure) 22 March 2005 and fitted with the same transmitter collar, but this time the collar was adjusted more tightly. The male was shot 5 January 2006, i.e. after nine months (Photo 4). The collar caused a very intense inflammatory condition, an open dewlap injury, and a damage of the lower jaw. Another unfavourable effect of the research concerned female 9 which locked its front left leg between its neck and the collar (Photo 5). These cases clearly demonstrate that a single collar fails to be a good solution in radio telemetry research on wild boar.



Phot. 4. Male 2 a year after being collared  
 Fot. 4. Odyniec 2 po roku noszenia obroży



Phot. 5. Female with a trapped leg (Photo by J. Zych)  
 Fot. 5. Locha z uwięzionym biegiem (fot. J. Zych)

Andrzejewski and Jezierski [1978], and Boisaubert and Klein [1984] used radio tagging research to demonstrate that wild boar is a sedentary species. The analysis of the observations in Zielonka GIC also proved that wild boar is attached to its home range. On average, the individuals observed used from ca. 80 to ca. 150 ha of area. With a forest compartment being ca. 25 ha in area, the individuals used the area comprising

3 to 6 forest compartments. The radio telemetry research showed that the largest home range in absolute terms – comprising two partial home ranges – was 445 ha, and the largest compact one 415 ha in area. A very high coefficient of variation in the size of home ranges (from 131% to 168%) indicated that the size was an individual feature.

The animals used different habitats depending on their sex. Home ranges used by any two males did not overlap with each other; they used two separate areas which also did not overlap with any female home ranges. These, however, could overlap with each other, and two female home ranges were found to overlap with each other by as much as 80%. These results are consistent with observations in Tuscany [Boitani et al. 1994], where female home ranges overlapped while male home ranges were separate from each other.

At night-time the wild boars moved at an average rate of 300 m per hour. The observed individuals had a daily home range varying from 7 to 83 ha (44 ha on average); its size was close to the size of the daily home range of wild boar in Germany (Lehrreier Mooswald; the daily home range was from 10 to 100 ha), but smaller than that in South-West France, i.e. 60-75 ha [Spitz and Janeau 1990]. Also the size of the daily home range showed no link with sex or a season. The thesis that wild boar is a sedentary species was also proved by the fact that young wild boars were mostly shot within 5 km from where they had been captured and earmarked. This is consistent with the results collected by Fruziński [1993] in the same area, by Stubbe [1982] in Germany, and by Donaud [1983] in France.

The findings published in 2004 as a result of the research on habitat preferences of wild boar [Frackowiak et al. 2004] in seven forest districts showed that this species strongly avoided coniferous habitats and mixed coniferous forests, while preferring broadleaved and mixed forests. It was also emphasized that the extent to which a given habitat was used depended on the proportion of its surface area in the total area where the animals occurred. The results presented in this paper are similar: 75% of locations were in broadleaved habitats that account for ca. 78% of Zielonka GIC's area. The number of locations in fresh mixed coniferous forest habitats as a percentage of all the locations (ca. 7%) is smaller than the proportion of these habitats in the total research area (ca. 20%).

The wild boars were most often located in Scots pine stands (ca. 63% of readings) and oak stands (20% of readings). Forests with other species accounted for less than 18% of readings. Similar results were obtained by Massei and Genov [1995], who examined habitat selection of wild boar in central Italy. In the research area, the animals were significantly more often located in Scots pine stands despite a relatively low proportion of the surface area of such stands in the overall research area.

Mixed forest stands with a high share of oak – prevailing in Zielonka GIC – are a habitat that is most attractive for wild boar [Fruziński 1993].

The largest portion of the research area is covered by forest stands aged from 30 to 100 years. Stands younger than 30 years and older than 100 years account for only 30% in the overall research area. The observed wild boars preferred over 30-year-old forest stands. This should be linked with the access of light to the forest bed, the resulting abundance of forest floor plants and the occurrence of essential undergrowth species. Significant proportion of oak, bird cherry and hornbeam in the undergrowth may constitute an important source of food as far as wild boar's diet is concerned. A high proportion of the undergrowth oak – with its attractive acorns – should be considered especially important (23% of observations were made in such forest stands).

The fact that the wild boar prefers forests with light-admitting canopy was also evidenced by the analysis of the stands with respect to their canopy density and the cover type.

The canopy density affects the light, temperature and moisture conditions which in turn determine the presence of various forest floor plants, microorganisms, and vertebrates. Most wild boars were observed in stands with moderate (54% of locations) and intermittent canopy (nearly 40% of locations). In most cases (almost 75%) the animals occurred in forest stands with a thin and thick sod layer, and if one includes the proportion of stands with herbaceous cover where the animals were also observed, these locations account to 83% of all the locations. The plants typical of such forest stands provide the wild boar with cover (raspberry, blackberry, fern, small reed shrubs) and a variety of food (shoots, rhizomes and rootlets), and attract rodents which are readily eaten by wild boar.

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## WYBIÓRCZOŚĆ BIOTOPOWA DZIKÓW (*SUS SCROFA*) NA TERENIE OŚRODKA HODOWLI ZWIERZYNY „ZIELONKA” – BADANIA TELEMTRYCZNE

**Streszczenie.** Badania dotyczyły funkcjonowania populacji dzika na terenie dużego (7,5 tys. ha) zwarteo kompleksu leśnego. Wykorzystując telemetrię, określono m.in. wielkość użytkowanych arealów osobniczych, arealy dobowe oraz prędkość przemieszczania się osobników. Wykazano rozdzielenie arealów loch i odyńców. Stwierdzono, że dziki najczęściej przebywały w drzewostanach z dominującą sosną na siedliskach LMŚw.

**Słowa kluczowe:** dzik, wybiórczość biotopowa, radiotelemetria, odłowy, unieruchamianie

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