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**THE EFFECT OF TRENDS IN AGRICULTURE ON POPULATIONS OF
BROWN HARE AND RED FOX IN CENTRAL POLAND
IN YEARS 1981-2008**

Abstract

The aim of the study was to describe changes in the size of population of the Brown hare and Red fox in years 1981 - 2008 in central Poland (mazovian region). Database of Polish Hunting Association and public statistics were used for calculations. The increase of values of agricultural intensity indexes was observed in the studied period. Since 1975, the number of tractors per 100 hectares grew from 1,7 to 10,3. Cereal production substantially increased (from 56,6% to 76,5%). The exclusion of arable areas from cultivation, resulted in decline of the hare population and was neutral for the growing population of the fox, that easily adapts in new conditions.

Key words: *hunting economy, hare, fox, hunting statistics,*

Introduction.

Arable areas, as the main mean of production, are of special importance for the national economy. The natural environment influences the level of agricultural intensity. In the past, it was the main cause of regional diversification in the intensity of managing (Manteuffel 1981). Currently, the scientific and technological progress enables the improvement in functioning and the effectiveness of the management in variable environmental conditions. The higher development of productive forces, the less important become the natural factors. In conditions of the market economy an economic factor remains essential. The level of the development of the agricultural production sector depends on the profitability of the production and remains regionally diversified in Poland. Establishing of large, highly specialized farms, the cultivation of big areas of the farmlands often causes disadvantageous environmental changes. Particularly interesting are not typically agricultural regions, but those being the subject of essential infrastructure changes. The progress in urbanization, withdrawing grounds from agricultural use, and simultaneous intensive development of remaining land have the influence on adverse quantitative changes of the populations of small game animals.

Periodical quantitative changes of the game species are the natural issue. However decreasing trends in the number of the small game animals in Poland is alarming (Wiśniewski 1999). On the basis of statistical data of the Polish Hunting Association there is regional diversity in living conditions for wild animals (Budny et al. 2010). Amongst most common causes of the reduction in the headage are: health problems, an intensification of the farming, changes happening in farmland management, poachers and predators (Motyl 2007). The decrease in the population of Brown hare seems especially alarming.

In 1960s and 1970s of the XXth century, Brown hare was the most common game animal in Poland. According to statistical data from 1970, 386.000 of hares were shot that year. Judging contemporary economic meaning of the Brown hare, it can be stated that it was the most important game animal of Polish People's Republic. Apart from the realization of the plan of shootings an exploitation of opened breeding was carried on. In 1970 altogether 77000 hares were caught alive (GUS 1986). Brown hare became the export animal, in mid-sixties they were taking out of the country about 50000 animals annually. According to the studies of the Institute of Ecology (Polish Academy of Sciences), in season 1964/1965 the statistical hunter in Poland hunted hares round about 5 times shooting even over 20 animals (Pielowski 1966). Statistical data from 2008 inform of live caught hares scarcely 163, what constitutes about 1% of population estimated on the basis of the spring quantitative state. The size of the population of the hare was assessed on 515800, whereas the shooting is being assessed scarcely as 23000 (GUS 2009).

Hares most often appear in areas with the extensive farming, with slightly diversified crops. Therefore, the intensification of farming is not favorable for hare population.

Red fox remains one of the most important enemies of the hare, very well adopting to changeable conditions of agricultural production space (Bro et al. 2000).

Task

The task of the presented study was to determine changes of the population of Brown hare and the Red fox in the Mazovian province in years 1981 - 2008. In the article an attempt of the assessment of causes of quantitative changes of the headage was taken.

Materials and methods

The analysis based on the statistical data of the Polish Hunting Association from years 1981 - 2008. In the purpose of determining changes of intensity of the crop and animal production regional statistical data from years 1975 - 2009 for the Mazovian province were used. On the basis of statistical yearbooks the number of tractors per 100 hectares, the number of animals per 100 hectares, average yields of 4 cereal crops, changes of the percentage of arable land structure and the change of the structure of sowings.

A state, acquiring the small game on the basis of annual hunting plans from districts of the present Mazovian province consider data of hunting statistics (Radom, Ciechanów, Siedlce, Warsaw, Płock and Ostrołęka).

Results of researches

A systemic transformation in 1989 initiated the process of creating the latest model of the farming in Poland. The restructuring of the public sector meaning the fall of big specialized arable farms in many cases can be recognized as the supporting factor for ecological treating the agricultural sector. In the short time however it turned out, that to come into existence started large modern private households, of whom functioning isn't supporting ecological production and the improvement in quantitative states of the wild game.

The mechanization of the farming, the change of the agricultural production space, the intensification of the plant and animal production at modern agricultural enterprises driving noncommercial households out of business definitely aren't

supporting the hare and remains indifferent for fox, easily adapting to new conditions and additionally immunized with vaccination against rabies.

Table 1.

Changes in Mazovian agriculture (1975-2008).

	1975	1980	1985	1990	1995	2000	2005	2008
Tractors per 100 hectares	1,70	1,96	2,16	2,40	2,58	7,60	9,70	10,30
Stock headage per 100 hectares	76,48	74,80	73,02	71,65	69,75	47,60	52,90	53,20
NPK w czystym składniku na 1 ha	152,33	152,42	150,73	154,00	151,60	76,10	78,00	115,00
Average yield of 4 cereals (dt/ha)	22,58	22,93	23,10	23,67	23,65	19,90	27,00	27,60
The share of arable land (%)	77,77	76,72	76,60	75,77	70,29	65,85	63,20	64,61

Source: GUS

Discussing Table 1, it should be noticed, that since 1975 the level of the mechanization of the Mazovian farming increased significantly. In mid-seventies on 100 hectares of the farmlands it was 1,7 tractors. The radical improvement took place after integration with the European Union. In 2008 on 100 hectares of the farmlands 10,3 tractors were used.

Applying machines influences changes of the agricultural production space. It forces (particularly in households intensifying production) proper management (mowing baulks and creating appropriate conditions of maneuverings of the equipment). The increase of the mechanization isn't supporting the small game and the maintenance of settlements correcting the offset we are reducing the possibility of living of some animals.

Since 1970s, a headage of animals was lowered, but intensity of the production definitely grew in special households. Fertilizing on level 115 NPK isn't supporting living of wild populations. Average crops (approx. 28 dt/ha) can't be considered high, but the slight improvement can be noticed.

In the agricultural grounds structure, a share of arable land had decreased from 77% in 1975 to 68% in 2008 (GUS). The part of the agricultural production space peculiarly in surroundings of cities will be reclassified to investment areas. The urbanization isn't supporting the wild game.

A structure of sowings shows a substantial increase in the share of cereal crops of approx. 56,6% to 75,4% in 2008. Currently, cultivation of cereals limited to 65% of arable lands means the greater mechanization of the crop production (GUS). Polish hunting grounds in the context of recruiting and the quantitative state of the wild game changed substantially since the beginning of 1970s. The situation of the large game is well. From mid-eighties the recruiting of the wild boar and the fallow deer increased.

In the small game we observe the opposite tendency. Due to effective outdoor and indoor breeding, an improvement in quantitative states is possible. Effective introductions are giving satisfying effects in the case of the assurance for animals of appropriate living conditions. The adaptation and the development of environment-

sensitive species is currently becoming the problem. Appealing to states of the small game from seventies we often forget how habitats have changed for animals adapting to changes and those, who react with the decrease of quantitative states. It is difficult to give one cause of the limitation of appearing of the given species.

Quantitative changes presented in the Table 2 and hunting bags of individual game species indicate the increase of Red fox population. Distinct growth can be observed up to year 2006. In 1981 the amount of predators on the area of Masovia was assessed scarcely as 5090. 1658 foxes were hunted, which is approx. 33%. In the year 2008, 13823 foxes were hunted (67% reduction in population). According to Kamieniarz and Panek (2008), amount of the fox is from 2 to 4 specimens on 1000 hectares. Domestic average in Poland is approx. 8 per 1000 hectares (in central Poland approx. 7). Nevertheless the height of intensity of shootings of the fox is enhancing chances of the reconstruction of the population of the Brown hare.

Table 2.

The population size and the hunting bag of Red fox and Brown hare in Mazovian district (1981-2008).

year	Red fox		Brown hare		year	Red fox		Brown hare	
	hunting	amount	hunting	amount		hunting	amount	hunting	amount
1981	1658	5090	25319	187472	1995	2858	6672	32758	120741
1982	2453	4803	49114	195232	1996	2205	6542	23178	96464
1983	2256	4893	68972	219116	1997	2408	7519	22163	91546
1984	2369	4752	52786	210433	1998	3703	9170	26909	95474
1985	2506	4948	48902	200074	1999	4515	10359	23737	103225
1986	2620	4931	43468	183896	2000	5484	12884	19672	89268
1987	3583	5434	33890	167378	2001	6351	12617	19876	89016
1988	2803	5201	45642	174838	2002	9522	16341	21946	98765
1989	2632	5111	47552	183452	2003	10181	17905	11981	95677
1990	2312	4774	43425	166597	2004	11812	19515	8753	91530
1991	2032	4793	46860	174099	2005	14499	22014	8415	97292
1992	1997	4697	50414	173382	2006	14952	23371	4507	96427
1993	1900	5071	42887	158541	2007	13829	21055	5623	89151
1994	2187	5745	40919	141209	2008	13823	20573	4118	95536

Source ZG PZŁ

In the case of the Brown hare in the analyzed period we observe distinct decrease. A drastic limitation of hares shows is the first mid-nineties (Table 2). The population decrease from 166597 (1990) to 96464 (1996) could be caused by the change of living conditions. The hunting is compensated with introductions program. Amount of introduced animals since 1997 increases. In 2008 in the Mazovian province 171 hares were released. One should however recognize insufficient these treatments in the relation to needs.

Conclusions

The mechanization of the Mazovian farming, changes of the agricultural production space, the intensification of the plant and animal production at modern agricultural enterprises driving households out of business the non commercial farms is not supporting the Brown hare population, remains indifferent for quickly adapting

to new conditions and additionally immunized with vaccination against rabies of the Red fox.

The increase of the amount of tractors to more than 10 per 100 hectares, high amounts of artificial fertilizers applied in the crop production (115 kg/hectare), the reduction in the share of the farmlands in the structure of using the land (to 64,6%), the increase of importance of the cereal crops influences for the reduction in quantitative states of habitat-sensitive Brown hare.

Since 1981 the hunting of the hare in central Poland decreased from approx. 25319 to 4118. However a shooting of the fox increased from 1658 to 13823 in 2008.

The introduction of the hare can support the population number. Many factors had the influence on the slump of the population of the small game since 1992 (changes in the farming, pressure of predators, illness), who altogether led the population of Brown hare to the lowest level.

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Summary

In the article changes of the population of the hare and fox were assessed in central Poland in years 1981-2008. Analysis of statistical data demonstrated reducing the population of the hare around 187472 to 95536, and the increase of the amount of the fox from 5090 to 20573. Increasing the amount of wild living foxes is supporting a downward trend shown from the beginning of the nineties. However the plan of hunting is not intense enough to reduce the population size, currently counting about 200000. The increase in mechanization and the intensity of rural production lowers the effectiveness of the introduction program.

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