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Life of game animals in transformed biotopes

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Abstract: One of the conditions of the species continuity is a natural living space (habitat), in which the species achieves its basic needs. Large area of agriculture and forestry monoculture are not conducive to existence of game animals. Permanent devastation of game preserves, windbreaks, liquidation of foraging sites and shelterbelts force the wild animals to feed in the field and forest crops. In modern agrotechnique – the usage of plant protection products deprives the wild species (eg the hare) of forage, on the other hand it causes contamination of food absorbed by animals. Not only does it disorganize the trophic pyramide, but also can cause permanent damage to the organism – environment networks system, which is essential for proper circulation of matter and energy in ecosystems.

The aim of the study is to draw attention to the effects of the changes in the biotypes caused by agriculture and forestry.

key words: habitat, hazard, game animals.

INTRODUCTION

The part played by present-day agriculture and forestry in reducing the population of hunting animals consists in the multidirectional influence on the biotope. This interference takes place on many levels of the biological organization. Changes occurring at the ecosystem, population and individual levels but also at the genetic level are of foremost importance in the methodology of hunting investigations.

The damage done by agriculture to the population of game animals is caused at various stages of the process of the plant production. Intensive farming, both of the arable land and of the forest, most often leads to negative changes in the biocenoses. As the adaptive capabilities of any wild-living species, and not only game animals, become exceeded it is now imperative to ensure sustainability of natural resources. A continuing decline of many economically useful wildlife populations is connected to progressive and often irreversible biotope devastation.

Today, the rapid decline of the partridge or hare populations in our country, is such an overt example of that adverse process. In less than 40 years Polish hunting grounds have lost 96% of the partridges and 89% of the hares.

The biological problem to be solved today are extensive areas under crops, most often under monocultures. As a result of land consolidation, the natural passageways between neighbouring biocenoses are being disrupted and at the same time the ecological niches are disappearing. This is true chiefly of agroecosystems, but not only so. Changes arising in the environment as a consequence of the misguided economic concept of the "management of farming" create a conflict between social groups – farmers and hunters, farmers and beekeepers, farmers, anglers and fishing farms. Inevitably, legal issues appear concerning settlement of the damages caused by animals in agricultural crops and, vice versa, those related to the repair of the damages to the nature and, in particular, to the populations of game animals incurred by agriculture. It should be noted that the damage caused by game animals is generated by the farmers and foresters themselves. Indeed, the introduction of alien species in agricultural crops entails a kind of behavioural changes in native wildlife. Ill-conceived actions result in the change of feeding preferences and interfere with reproductive processes for instance in the wild boars – which are the main perpetrators of damage to crops. The lack of knowledge concerning the biological behaviour of deer population – or its disregard – results in some damage to forest ecosystems. Only the changes in work organization, timing of treatments (late cleanings, early thinning, etc.), can mitigate or even prevent bark-stripping by deer. Many positive examples of the co-existence of the forest and game animals are provided by the work done at

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the regional forest administration office at Kluczbork, the Opole region (Pypłacz, Pypłacz, 2009). In turn, decline of woodland gallinacean game birds (capercaillie and black grouse) indicates the long-term changes in biotopes of these species, associated with the intensification of forestry that was brought down to the crop production-style management. These processes indicate a far-reaching human interference in the complex biological systems such as a habitat, an ecosystem or a biocenose. We cannot ignore the fact that food surplus obtained in agricultural production is lost as a result of deterioration, as a consequence of incorrect storage. Losses due to improper storage can reach even 40% of the final product. Wheat grain and other agricultural products are then assigned to the production of solid biofuel (pellets, cubes or pucks), burned in central heating furnaces, or fireplaces. Viewed in this context, damage to the agricultural crops caused by hunting animals accounts only for a little fraction of a much larger total.

THE CHANGES OF THE LANDSCAPE SPATIAL STRUCTURE

One of the conditions of continuity of the species is a natural living space (habitat) in which the species will realize its basic needs. The habitat as part of the biosphere is characterized by a specific combination of environmental factors or parameters allowing the functioning of the organism. Living conditions in biotopes are evolving faster and faster as a result of constant human intervention. This is a consequence of the urban and rural sprawl and of the expansion of the road infrastructure, detracting from the areas previously occupied by animals.

Mid-field woodlots, shrublands and game preserves, field borders, ecoton areas, ponds, windbreaks which used to be admixtures in the biocoenotic monotony of the field landscape are now either declining in area or disappearing. It is all too frequently that we see game refuges or little ponds become illegal rubbish dumps for neighbouring villages and settlements. A consequence of those changes for different species of game animals is the altering of their food resource base and of their living conditions. Abundance and distribution of forage base can contribute to the reduction of energy losses associated with searching for food (especially in winter) and to the maintaining of good condition necessary for the proper conduct of physiological processes. In the case of deer, the ecotone may contribute to more even distribution of animals in the area of their existence (Brzuski, Hędrzak, 2002 – acc. to Bobek et al., 1992). It is not possible to ignore the fact that the ecotone areas significantly reduce the damage caused by deer, both in forest and field ecosystems.

The biotope, in the ecological sense, presents a very complex biological system. People interfere in it through different management operations. Wild animals moving between ecosystems become a permanent channel of the flow of the energy and organic matter. Together with the matter they introduce different chemicals, which were carried along with the agricultural practices into circulation in the environment. Under natural conditions, undisturbed by humans wild animals are the link of ecological succession. Carrying seeds and spores between the ecosystems, they integrate these ecosystems. Their role in this process is significant. Knowledge of the participation of game animals in the biocoenotic process allow the functioning of the habitat to be used rationally. The development of wildlife populations and therefore intensity of reproduction and lifespan of individuals, their density, and biological production of populations, which may be used by the host of the hunting-ground, is dependent in the considerable degree on the landscape structure and on the processes that take place therein. The possibility of the compensative use of the ecosystems of different forage supply potential contributes positively to the welfare of game animals. The compensation of food resources occurs when the lack of food in a wild ecosystem is able to be satisfied in the neighbouring ecosystem, such as during the "winters of the century" appearing in our climatic zone every few years. Homogeneous field surfaces (monoculture) must be sufficiently small, if the movement of animals between them takes place every day or even several times a day. The structure of the landscape, the deployment of its refuges and the distance between them, determine the course of the migration routes of animals. Communication routes, fenced fields (electric shepherds) intersect the migration routes, forcing animals to overcome often dangerous barriers (eg highways). Preserving the diversity of ecological niches in the landscape contributes positively to the whole habitat. For example, the presence of mid-field shelterbelts influence on the yield of the crops in the micro-climatic range of its impact thus increasing the yield of cereals by 5–15%, sugar beet by 5–10%, potatoes by about 20% and the yield of vegetables compared to the yield in open areas by as much as 50–70% (Wilusz, Jaworski, 1960).

The diversity of ecological niches is important not only in fields, which gradually become more and more monotonous and poor. Also, in forest areas, the monocultures will benefit from the introduction of even small areas with different species composition (biocenotic game preserves). If all of the different land-use patterns are based on the use of different ecosystems, and their mutual mosaic location creates a landscape made by man then it is important to leave some space for wildlife and hunting management. The transformations of the landscape restrain the existence of permanent passageways, changing the quantitative and spatial relations in the structure of crops, in the age composition of forests, the availability of space. It causes the substantial reduction in the efficiency of the hunting management, farming and forestry. The unification in the use and management of the space is in contradiction to the principles of conservation of nature, including the preserving space for the game animals.

THE REDUCTION OF ANIMALS HOME RANGES

The space of the wild species undergoes a permanent reduction, the process is progressive, and remains in functional dependence on the exponential growth of human population. This is the global phenomenon, very clearly perceptible around the world. Until recently it was estimated that the home range area per individual of a roe deer ranged from 100 to 150 ha, and nowadays it is estimated at around 40 hectares. An example on a local scale is the reduced area of roe deer originally inhabiting an area 143 306 ha in the Opole region (Sporek, Sporek, 2009).

The study was conducted based on 14 field game shooting districts, and 12 hunting forest game shooting districts. The total area of the analysed units, was respectively; 68 097 hectares of meadow/field and 75 209 ha of forest. However, after reducing the surface area (the surface after the exemption referred to in Article 26th of the government law/act of 13th Oct. 1995 „The Hunting Law") was 63 319 ha for the hunting districts in the field and 70 816 ha of the hunting districts in the wood. In absolute numbers, roe deer habitat on the field is reduced by 4 778 ha, and it is a permanent loss of space for this species by 7% compared to the original territory, while the deer forest habitat is reduced by 4 393 ha (about 5.84%). In total, the hunting economy has lost more than 9000 ha in the analysed area. The area of permanent loss of the territory does not include areas not accessible for deer in the interim period – ranging up to a dozen years – is a result of the fencing of forest crops, young tree stands, edges of forests, establishing of electrical shepherds in the fields by farmers. In the analysed area, the share of the forest complexes was 3.1% of the total area (the smallest forest complex was 20 hectares and the largest one – 533 hectares). A controversial issue that remains to be solved are the restrictions to or even a total ban on game shooting in the vicinity of designated hiking trails, bicycle paths or ski-routes. It is mainly concerned with areas which contain elements of tourist infrastructure such as information boards, marked rest stops equipped with seats, etc. which are built close to the existing hunting facilities. Safe hunting is not possible at those sites. More and more often, this situation coincides with the problem of hunting-related damages occurring at those places, and, at the same time, with the claims for loss settlement put forward by local hunter associations. It should also be noted that the hunters' point of view is ignored in the evaluation of local investments as is the opinion of biologists who inform about wildlife migration routes.

THE EFFECTS OF CHEMICAL PLANT PROTECTION IN THE BIOTOPE

To combat harmful factors influencing the economic effects in agriculture and forestry, the wide range of chemicals is used. For example, fungicides are used to combat fungi, insecticides are employed to exterminate insects, rodenticides control rodents, acaricides kill mites, herbicides suppress the growth of weeds, and those bacteria that cause crop diseases are controlled by bactericides. Generally, all these agents are referred to as pesticides or biocides.

Initial achievements obtained by the use of chemicals in the fight against pests and weeds, and as a result, the effective increase in yields – for a long time masked the negative aspects of this method. Only with time it became apparent that, while not being quite perfect, chemical control can be a two-edged weapon.

Attention is drawn to the fact that we know now about 13 million chemical compounds, about 100,000 of them are produced on an industrial scale, and each year approximately another 100–200 thousand new compounds are identified, of which about 2000 are annually placed on the market (Siemiński, 2001).

According to the report of the U.S. Environmental Protection Agency – EPA 1998 (Chemical Hazard Data Availability Study) only 7% of 3,000 chemicals used in significant quantities in the U.S. have been sufficiently tested for their impact on human health and the environment (Siemiński, 2001).

In the vast majority of agrarian activities, the farmers lack knowledge about the effects of chemical interference in the biological system. They are ignorant of the consequences of the impact of active substances and their metabolites in the ecosystem. Even given the optimistic assumption that farmers have full knowledge of the consequences of their own chemical treatments and that those treatments are done exactly according to the agricultural recommendations, as many as 20% of apiaries become poisoned (Banaszkiewicz, Lipiński, 2009). We would not be aware of this were it not for the beekeepers and their organizations and the unique interest of the researchers in those useful insects. But what about other species that are present in any analogous trophic networks? Do really the sprayed toxins act only on the targeted organisms?

The transforming of the environment is the result of rapid and high profit-oriented agricultural activity with minimum inputs of labour. This postulate can be fulfilled under the assumption that 95% of agricultural practices will be made using chemicals. Chemical plant protection products, also known as pesticides, are a small group of toxic substances intentionally introduced into the environment. The aim of this treatment is to combat harmful organisms, A side effect is that, at the same time, they are toxic for the organisms identified by the humans as useful (eg bees) and neutral ones (if there is such a thing as "neutral" in biocenoses). Animals, living in the wild, in the environment treated with plant protection agents, are extremely exposed to toxic substances, because they are located at the top of the pyramid of the trophic network. The negative consequences of the modern agrarian technology do not only

concern the game animals existing there, but also endanger the safety of the people's health. We must be aware of the complexity of the biological system in which farmers intervene by introducing the biocides and xenobiotics.

If we ask the question whether modern agriculture does damage in populations of wild game, then we should answer the question: what happens to the biocides and xenobiotics introduced with agrarian treatments into the agroecosystem. The specific question would be: "What is happening with the glyphosate as a herbicidal agent of a broad spectrum of activity after spraying the field? Glyphosate ($HOOC\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}NH\text{-}PO(OH)_2$), is a non-selective herbicide that is absorbed by the leaves of annual, biennial and perennial plants. Incorporation of the glyphosate resistance in the genetically modified crops of oilseed rape is a widely used strategy in modern plant breeding. With this approach, the field may be dusted during the crop growth and development. All other plants are destroyed, but the crop itself remains intact. This technology gives rise to complex environmental consequences associated with this strategy. One of the many environmental consequences is the total elimination of the food base allowing continuity of the existence of such species as the hare. The literature data indicate that this species needs more than a hundred species of plants for the normal development and maintenance of physiological functions including reproduction. The effectiveness of herbicides also effectively reduces and eliminates the population of hares in our fields, depriving them of livelihood ie food.

According to the International Union for Conservation of Nature (IUCN) data, up to 27% of mammal species shows presently a declining trend (33% – lack of information, 32% – stable, 8% – growth). In the Opole region the number of the European hare *Lepus europaus* declined, by more than 80% within 10 years (1994 – 34,753 individuals, 2004 – 5,410 individuals), which, in the light of international criteria for the IUCN classifies this species as critically endangered (Sporek, Wężgowiec-Bagrowicz, 2009). The cause of such a substantial reduction of the number of hares must be sought in the intensification of agriculture and in particular in the use of pesticides. The current register of the Minister of Agriculture and Rural Development (Ministerstwo..., 2008), contains 795 plant protection products approved for use in Poland. The legal act of the European Union is the Council Directive 91/414/EEC of 15 July 1991. A total of 149 plant protection products offered for sale in the Opole region were analyzed based on these acts. It was found that:

– 58 are permitted to be marketed in Poland, although not on the list of the EU,
– 8 are approved for use by the EU directive, but they are absent in the national registry,
– 59 are allowed by both acts,
– 24 are not authorized by both acts.

The effectiveness and mode of action of the biocides is defined by the content of the active substance. The analysed plant protection products consist of 113 active substances present in different concentrations. Active substances contained in plant protection products define the direction of the toxic action (the number of preparations is given in the brackets):

1. very toxic to the aquatic organisms, with long-term adverse effects in the aquatic environment (72),
2. highly toxic to bees (10),
3. toxic to bees (6),
4. limited evidence for carcinogenicity (17),
5. causing hereditary genetic defects (5),
6. impaired fertility (6),
7. deleterious effects on the unborn child (21),
8. possible risk of irreversible changes in health status (2) (Sporek, Wężgowiec-Bagrowicz, 2009).

In the studied group of preparations there are fungicides, herbicides, insecticides, desiccants, growth retardant and seed treatment products (eg for the protection of cereals, oilseed rape, maize, vegetable and fruit crops). The production of the plant protection products in 1990–2007 in Poland increased from 19.7 to 42.7 thousand tonnes, together with a simultaneous decrease of the cultivated area from more than 18.5 millions of hectares in 1990 to 16.2 millions in 2007.

The active ingredients were selected in this group that are carcinogenic and potentially adversely affecting the fertility. These are compounds from the triazoles group – flusilazole, triadimenol, tebuconazole, cyproconazole, epoxiconazole; benzimidazoles – carbendazim, thiophanate-methyl; dinitroaniline derivatives – trifluralin. Triazoles are a group of compounds used in very low doses of 0,015–0,025 kg/ha active against numerous fungal pathogens.

Some chemical plant protection products may cause fertility disorders (compounds based on triazoles, benzimidazoles, dinitroaniline). Fungicides based on triazole derivatives are used, inter alia, in the protection of cereals (rye, spring and winter barley, spring and winter wheat), sugar beet, oilseed rape. It was proved (*in vivo* and *in vitro* on rats) that triazoles (including flusilazole) cause craniofacial and heart abnormalities in the fetus and (Menegola et al. 2001), also induce alterations to the structure of the throat and the fusion of aortic arches (Menegola et al., 2005). Directive 91/414/EEC does not allow marketing and using them (whereas the national registry does), but their sale is growing steadily within the country, and they are the fourth largest group of fungicides used in Opole region. Carbendazim, a compound belonging to the benzimidazoles, widely used in the cultivation of cereals, oilseed rape, sugar beet, causes disorder of the spermatogenesis process of rats (Rajeswary et al., 2007) and causes male infertility of the quails (Aire, 2005). Both the Directive 91/414/EEC and the national register of plant protection

products allow for marketing and use of carbendazim. The fungicides preparations based on benzimidazoles reached the peak of the sales in 2005 in the country (Ministerstwo..., 2006). Such fungicides rank second in terms of use in Opole region. Another compound, which is derived from dinitroanilines is also widely used in plant protection. Trifluralin administered to pregnant female rabbits causes anorexia, general emaciation of the body and weight loss. In some cases miscarriage occurs, and after the birth, only some of the young are able to survive (Byrd et al., 1995). Trifluralin is not allowed to be used according to both of these acts. Detailed histological-toxicological studies on the game animals have shown that animals dwelling in the chemically contaminated environment lose weight and are less resistant to pathogens and organic disorders, and also show reduced sexual activity and fertility. This is all the more disturbing because – in contrast to the acute fatal poisoning, which concerns only a certain number of animals – a chronic poisoning, as manifested, inter alia, by the degeneration of the internal organs, infertility, and starvation of the body relates to a much larger number of individuals in the population. It is very frequent that the adverse effects of poisoning do not show up until the next generation.

The populations of small game animals having their food resources systematically chemically treated (hares, partridges, pheasants) are especially at risk. Boteva and co-authors research in Bulgaria (acc. to Borowiec, 1976) showed that number of birds in the pesticide-treated area was 30 times lower than in the control fields. It is only in the season after the treatment that the number of the birds increased, but it was still four times lower than that on the untreated surfaces. The searching for not contaminated food is very difficult or even impossible in a case of the chemical treatment of a wide area. Therefore, we speculated that the adverse genetic and development modification of the warm-blooded organisms, including humans caused by the pesticides, incalculable in size and in consequences, pose a greater threat, than the direct acute toxicity. The possibility of effective intervention on part of the specialists regarding the acceptance of pesticide usage, the concentration of applied chemicals, the size of the treated area, timing and frequency of the chemical treatments, etc., would reduce the negative impact of pesticides on the animals by eliminating the inappropriate chemicalization of their habitats.

SUMMARY

Wild game is an integral component of the natural environment, and therefore the management of their populations should be in accordance with the rules of biology. Progressive changes in the environment caused by human activities led to an imbalance in the ecosystem. Continuous changes in biotopes cause behavioral changes of game animals in their habitat as well as in their food preferences. Despite considerable progress in chemical plant protection there is still a major threat to wild species. It can be assumed that the main cause of this phenomenon is the lack of continuous monitoring of applied pesticides, timing of treatments performed and the quality of the products used.

According to the principle of sustainable development of agriculture and forestry, the natural resources should be used in such a manner and pace that will allow us to preserve and maintain biological diversity and productivity at such a level that it does not lead to the destruction of the trophic network links)

The new mid-fields shelterbelts should be created and the last existing ones should be preserved and maintained because they are often the only chance for the survival of many species in the highly impoverished phytocoenoses. It is therefore necessary to make further efforts and to bear costs of their implementation in agrocoenoses.

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