INFLUENCE OF LANDSCAPE ANTHROPOGENIC CHANGES ON THE GREY PARTRIDGE POPULATION IN THE CZECH REPUBLIC. A REVIEW

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Introduction

The grey partridge (Perdix perdix) is a game-bird widespread and common throughout a large range. This partridge breeds from the British Isles through most of Europe and Russia into the western Asia, then to Mongolia, and has been introduced widely into North America and New Zealand. The grey partridge used to be a common bird of agricultural areas throughout Europe but nowadays here, it is a rare bird [14]. Rapid and broad reduction of the suitable habitats for the species, caused by agriculture intensification, has resulted in a dramatic decline of the partridge in Europe [4, 38, 54, 56]. Since the thirties, European breeding stocks of the species have dropped by less than 80% [40]. Although the species was stable or increased in many eastern European countries during the period 1990–2000, it has continued to decline throughout most of western and central Europe, BirdLife International [6] drew attention towards this species. As a highly appreciated game bird the grey partridge is in the centre of attention and there are various studies and methods of the partridge population restoration. In this revue we would like to analyze driving factors of the partridge population decline and suitable ways to restore the grey partridge population in the Czech Republic with evaluating effectiveness of restoration attempts taken in the country.

Materials and methods

We've studied several publications on the problem of restoration and stabilization of the grey partridge populations in Europe with the higher attention to the attemps taken in the Czech Republic. Those publications were studied with the evaluation of the main factors of success and main negative factors that influenced these attempts in the Czech Republic. Also information about the main causes of the population changes was analyzed from these puplications from a historical point of view, stressing the changes in agricultural landscape and techniques. Main methods used for the grey partridge management were evaluated in the review.

Results and discussion

In the year 1899 in the Czech Republic, Moravia and Silesia 519 135 partridges were caught [24]. In the thirties of the last century in the territory of our country (former Czechoslovakia) were even more than two million partridges [31]. The Second World War couldn't be called a prosperous time for the partridge as birds were hunted due to famine [31]. Until the fifties of the last century the grey partridge was the main hunting species in the Czech Republic [51]. A dramatic decline in the number of partridges began from times of rural socialization in the fifties and continued in the sixties and seventies of the past century. The partridge population in the eighties in most places in our country has been totally torn apart [19, 54]. The present population of the partridge in our country amounts to 11.000–22.000 pairs in the country.

The partridge is present all the year round in lowlands, uplands, highlands, fields and pasture lands including mountain fields, suburban areas (ruderals) etc. in conditions of the so-called cultural steppes, in the environment created by humans for centuries [16]. The most suitable habitats for the partridge there are varied landscapes, with alternating smaller areas of fields with various crops, grasslands and complemented by sparse vegetation, shelterbelts, fencerows, small watercourses and field channels, old fields with undisturbed herbaceous cover, roadsides, farmsteads, field boundaries, grassy strips, weeds (e.g. [7, 12, 26, 39, 48]).

The grey partridge prefers open, low-intensity, mixed farmland [2], but in Western Europe it also occurs commonly in intensive cereal ecosystems [9, 45]. Habitats with weeds in particular provide seeds, which is a major component of partridges' diet year-round [20, 38]. It is also important to take into account, that less disturbed weeds with permanent cover tend to increase the number of insects [32], which are an essential food source for the partridge's chicks [17] and can maintain higher reproductive success of birds [52].

AGRICULTURAL LAND MANAGEMENT CHANGES AS A CAUSE OF DECLINE

The size and dynamics of partridge populations in Central Europe are known to be tightly linked to the type and intensity of agricultural land use [58]. There is an empirical evidence for the negative correlation between biodiversity and farming intensity, which comes from spatial analyzes between areas differing in agricultural intensity [3, 57], and from time series, correlating biodiversity decline with increasing intensification [13, 47].

It is well established that patterns of farmland biodiversity depend on political and economic systems [4, 13, 18]. The beginning of the grey partridge's disastrous trend fall in the CR was in fifties of the 20th century. Changes connected with soviet methods of agriculture and collectivization had a negative impact on the game species on the agricultural land from the environmental point of view [21, 31, 54]. Intensification of agricultural production and changes in agricultural land management practices were main reasons for the partridge's population reduction in the Czech Republic. This was a particularly extensive land consolidation using a large association of field lines, draining wetlands and the changing of watercourses, use of harmful chemicals, use of efficient and faster automated equipment, vast tracts of monoculture etc. (e.g. [7, 12, 26, 39, 48]).

Ellenberg [15] and Mooij [27] point out a possible negative correlation of the grey partridge abundance with the amount of nitrogen fertilizer applied in agriculture. One of the most important factors influencing the negatively chick survival rate of the species in Europe was the increased pesticide use since 1950–1970s [39]. This could directly poison birds or indirectly affect a decrease of grey partridge chick food availability, because there are devastating effects on chicks dependent on insect food just after the hatching stage [14, 28, 55]. In England, a distinct influence of increased use of pesticides with the consequence of elevated chick mortality has been recorded [39, 40]. However, in Central European countries, habitat changes due to agricultural intensification and the abandonment of traditionally cattle-grazed pastures could play a more important role than management intensity and use of pesticides [4].

Game refugees and small fields ideal for the partridge were disappearing. Extensively grazed wastelands, which provided nesting cover and chick-rearing habitat for the grey partridge, were very attractive during the 1960s, but those became rare because of agricultural intensification and urbanization, and the majority of them have been left ungrazed and overgrown by dense shrubs and high trees [41, 54, 58]. These processes led to a progressive decrease in grey partridge populations in the Czech Republic, reaching a decline of approximately 95% between 1965 and the end of the 1980s [49, 54]. The increase in intensity of agriculture in the Czech Republic until 1990 was probably the general reason for farmland bird decline in the country, while there was an absence of set-aside land [43, 50]. The conditions of the Czech countryside, despite the optimistic expectations of early 90ies, had not improved much even after the change of the political regime in the conditions of the market economy [31, 50]. The intensity of agriculture was dropping steeply and remained quite low until 2003; while the was an influence by the habitat loss – fields were converted to meadows or even were afforestraited [43]. Reif et al. [43] found that populations of most farmland species declined until 1987 and again after 1993, as there was probably no enough time for bird population recovery.

The grey partridge, as a species closely associated with farmland habitat [44], can suffer not only from the reduction of the total area of arable land, but also from agricultural intensification on remaing areas [4] and these factors contribute to strong negative population trends [44]. The main causes still continue to threaten the partridge population's existence, in the last decades the population of the partridge in the Czech Republic was decreasing mainly due to the unification of agriculture fields [46, 51]. Among modern management practices that have negative impact are the mowing of forage during the breeding season, plowing of crops before winter, extensive monocultures and the use of chemicals (fertilizers and pesticides) [51].

Generally farmland heterogeneity is known to be a key factor in the maintenance of farmland biodiversity [5, 57]. The loss of structural diversity in open agricultural landscapes represents a key factor with the partridge abundance being linked to the frequency of hedges, field margins, and forest and shrub islands in the landscape mosaic [16, 22, 27, 34, 41, 42]. Panek [33] emphasizes on the elevated hatchling mortality for Polish populations in the context of decreasing structural heterogenity in the landscape which he linked to decreases in insect abundance. However, in Hungary an expectation that after privatization of farmland will increase landscape heterogeneity and game populations failed [4]. Similarly Bro et al. [9] also found a lack of increase in partridge population after increasing spatial heterogeneity with a strip creation scheme.

PREDATION AS A CAUSE OF DECLINE

Predation was claimed as the main factor of population decline after 1970's in Europe [14]. It was the main mortality factor during breeding season in researches in France (70% of losses; [8]) and Poland [34]. There is a strong influence on the survival of the partridges from high levels of predators, especially foxes, martens and wild boars and uncontrollable spread of some non-native predators and freely walking dogs and cats [31, 39]. In the Czech Republic predation pressure on partridges is a result of legislative protection of predators, their nationwide vaccination, improving of the conditions for the existence of predators. Growing of poplars in tree lines and isolated game refuges are ideal conditions for avian and small carnivore predators and also can become ecological traps for partridges, however, control of predators is lacking [31]. According to Potts & Aebisher [40] reduced predation control may explain the higher predation rates. Partridge predation rates are naturally high throughout the year and availability of cover is a key factor for the partridge survival [1, 36, 39]. However, winter losses are among the biggest problems of partridge management as the adult predation rates are high in winter [36]. When the partridges pair up in the late winter and early spring, they are particularly vulnerable to attacks from birds of prey [10], but also food is often hidden deep under the snow and for the partridge is difficult to find [36].

REINTRODUCTION ATTEMPTS IN THE CZECH REPUBLIC

In the Czech Republic attempts were made to reintroduce captive partridges for the stabilization of wild populations , using the above mentioned methods, mostly by individuals or small groups [23, 30, 31, 46]. Such strengthening of populations is done with the captive rearing and keeping in pens. However, the benefit of this approach is seriously reduced by a relatively low survival rate of the reintroduced individuals [37, 46]. In most cases (see table 1), there are no records about the success of reintroductions; those recorded are without further monitoring.

Examples of reintroduction attempts in the Czech Republic with success evaluation

Reintroduction attempts	Year(s) of release(s)	Number of partridges (p) released	Success Evaluation	Positive factors	Negative factors (or problems faced)
Local hunting ground of VaFU [31]	80's	X	**Lacking monitoring.** Birds expanded into the nearby hunting grounds	X	Loss of public interest
MS Mořkov [31]	90's	X	X	X	Programme was closed because of Staphylococcal infection
Programme in Nový Jičín «Stabilization of the g.p. population on Fulnek and surroundings» [31]	From 1997 – 1st programme From 2006 – 2nd program (planned for 10 years)	1998-47 1999-100 2000-50 2001-50 2002-50 2003-8 2004-30 2005-60 2006-50 2007-32	**Successful** 1st programme: local dispersed population turned into patchy pattern population	Improving of landscape Predator-control Cooperation with local authorities and 10 hunting grounds Training events	X
Stodůlky (Prague) [37]	1999	10	**Failed.** Monitored with telemetry; all were depredated	Birds were in acclimatization aviary before the release; monitored	Predation was the main cause of mortality
Žďársko (Milešín) [23]	2000	27	X	Methods to avoid inbreeding, marked before release	No information on monitoring
Librantice [29]	2007	15 pairs	**Lacking monitoring.** Released population is observed in hunting grounds	Birds marked before release, released into bio-corridors	No information on monitoring

Note. X – no information available in the publications reviewed.

The habitat changes resulting from modern agricultural use have apparently resulted in an altered preference of land use types, even though the preferred vegetation types of the partridge remained the same. A number of authors have stressed that a high diversity of habitat types in the agricultural landscape and the existence of small patchy structure may promote high densities of the grey partridge [16, 22, 35, 42].

Agricultural intensification has resulted in an overall increase in vegetation density, but also has led to a scarcity of the herbaceous field flora and arthropod fauna due to improved weed control methods, and an accompanying increase in chick mortality [39, 40]. The abundance of invertebrate food is particularly important for chick survival and reproductive success [25, 32, 39], and establishing ecologically enhanced areas in intensively cultivated regions improves the availability of suitable nesting habitat and food resources [8, 28, 35]. Wubbenhorst [58] has shown that the reproductive rates of the birds breeding in the appropriate residual habitat islands and survival rates of their chicks can be relatively high even if the regional population density is low, the partridge sought refugees in fallows and field islands and could become independent of the insect abundance in the grain fields.

Buner & Schaub [10] have observed that released partridges preferred the parts with the highest density of ecologically enhanced areas and providing a mosaic of wild-flower strips and hedges was the crucial ecological improvement that restored the area to allow the released birds to survive and reproduce. That's why farmlands should be prepared for re-colonization by partridges by providing such landscape structures [31, 41] and those are the first-rate measure of preparing the re-introduction of the species [10].

Conclusion

The partridge population in the Czech Republic is endangered, and without our support, its future is uncertain. A number of factors have contributed to the dramatic decline in the grey partridge population from the 50's of the 20th century, including agricultural intensification with the introduction of pesticides and herbicides and, which are also modern-day farming practices, resulting in a loss of important food for young partridges as well as a habitat loss [4, 54]. The key mortality factors of partridges in the wild are poor food supply during the year, the loss of shelters and safe places for nesting [52]. Those are also supported by a lack of interest in the species by game managers and predator control. It is important to note that the effect among these factors are often aggregated or even multiplied.

However, nowadays the interest in reintroduction of the species is growing in the Czech Republic. It is also supported by the fact that the partridges are easy to take care of in the wild because they have small nesting territories [53] and stay near the place they were born or released. Partridge breeding is relatively inexpensive, easy to reproduce thanks to game managers, who have experience in breeding, releasing, pen-rearing, winter feeding and protecting the natural environment in our country.

Reintroduction attempts, done in our country, show that a successful reintroduction programme should not only consist of the releasing event, but should be supported by appropriate preparation of the environment, by winter feeding and control of the territories, where the partridges were released. Providing a mosaic landscape, which was planned, taking into account the needs of the species, is an important ecological improvement that proves the survival of the released birds. For this reason farmlands should be prepared for re-colonization by partridges by providing such landscape structures. The lack of monitoring of the released population could make difficulties with evaluation of such programmes of reintroduction and stabilization of wild populations.

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