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REVIEW

Decline and potential recovery of the European grey partridge (*Perdix perdix*) population—a review

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Abstract Grey partridge populations showed drastic decreasing numbers throughout Europe. Existing knowledge of the causes of decline and the effectiveness of conservation measures was reviewed. Population studies from the UK indicated three periods: a stable population before 1950, sharply decreasing numbers in 1950–1970 and a continued decline after 1970. Other European studies fitted into this picture, with a 10-year lag in each period. The onset of population decrease corresponded with a sharp decrease in chick survival mainly caused by reduced insect availability due to pesticide use. Several factors caused the continued decreasing numbers after 1970, such as decreased hatching success and an increased role of predation. Measures to restore partridge numbers should firstly focus on the main cause of population decline, that is, improve foraging conditions to increase chick survival rate. Next to creation of special partridge habitat, conventional agriculture offers good opportunities to improve foraging conditions. Only when an integrative approach is adopted may large-scale habitat improvements be realised to restore population level to the level before 1950.

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Introduction

Many bird species typical of the agricultural landscape have shown dramatic population declines during the last decades in Europe (Tucker and Heath 1994). One of these species is the grey partridge (*Perdix perdix*). The grey partridge used to be a common bird of agricultural areas throughout Europe but is nowadays a rare bird. With the exception of Russia and Czech where numbers recently still increased, all European countries have shown a decrease in population size ranging from 1% to 80% in 1990–2000 with an overall decline of 30% (Birdlife International 2004). As a result, not in the least because grey partridges are highly appreciated game birds, there has been much international attention for the species. Many studies have been carried out to the causes of the population crash. Next to that, the effectiveness of restoration measures to reverse the population decline has been studied. Scientific knowledge on the causes of decline is crucial and shows the proximate factors restoration projects should focus on. Furthermore, knowledge on the effectiveness of restoration measures shows which measures should be adopted and are likely to be successful to reverse the population decline. This review evaluates which driving factors determine the population decline of the grey partridge to show which are the main aspects to improve to restore grey partridge numbers.

Three periods of population change

The hunting bag statistics from the hunting estate Holkham in North-Norfolk, UK, represent one of the longest available data sets (1793–1993), indicating fluctuations in grey partridge population size (Potts and Aebischer 1995). Although hunting bags have the major drawback that they are density dependent, hence exaggerating fluctuations in population size, they do give an indication of changes in population size in the long term. Based on these figures, three periods can be distinguished. The first period from 1793 to 1950 is characterised by high hunting bags of several dozens and some peaks of more than hundred grey partridges per square kilometre per year. The second period, 1950–1970, showed strong declining hunting bags up to only a few individuals at the end of the 1970s. The third period, from 1970 onwards, shows a further but slower decline of hunting bags. The high numbers of grey partridges that were shot annually before 1950 never reappeared ever since.

A similar pattern appears from spring counts of grey partridges in the UK: high breeding pair density before 1950, followed by a strong decline in 1950–1970 and a continuous further decline after 1970 (Potts 1986; Potts and Aebischer 1995). Other long-term monitoring data of grey partridges in continental Europe, originating both from west and central Europe, fit into this picture (Hungary: Báldi and Faragó 2007; Poland: Chlewski and Panek 1986; Panek 2005; France: Birkan 1985; Netherlands: Bijlsma 1990). The difference between the UK and populations in continental Europe is that the period of strong decline is taking place approximately 10 years later in continental Europe, in 1960–1980 (Potts 1986, see Figs. 1 and 2). Important to note is that the crash of the population typically occurred in a relatively short period, often within 10 years followed by a much slower rate of decrease. The average spring density in the UK declined from more than 40 pairs/km^2 in the early 1950s to less than 10 pairs/km^2 at the end of the 1960s (Potts 1986) and declined further to 5 pairs/km^2 at the end of the 1980s (Potts 1986; Potts and Aebischer 1995). The continued decline from the 1980s onwards is in absolute terms much smaller than that that occurred in the preceding period (1960–1980).

It thus seems to be a general picture that the grey partridge populations in Europe showed a strong decline in 1950–1970 in the UK and 1960–1980 in the rest of Europe, followed by a, in absolute terms, much smaller decline in the subsequent period. The causes of these changes in population size differ between these distinct periods and will be subsequently addressed.

Population changes before 1950

Population studies of the period before 1950 are rare. Next to estimates of hunting bags, often no figures are available from this period. Exceptional is the study of Potts and Aebischer (1995), which presents data on chick survival rate from the period 1903 to 1938 in the area 'Great Witchingham' in the UK. Yearly fluctuations in chick survival rate accounted for more than 50% of the annual variation that occurred in hunting bag figures from the same area. This showed that the yearly fluctuations in chick survival, mainly determined by weather conditions, was by far the most important factor explaining grey partridge population size in the period before 1950. Also Blank et al. (1967) showed for another study area in the UK that chick survival rate was the key factor determining yearly fluctuations in population size in the period 1946–1961.

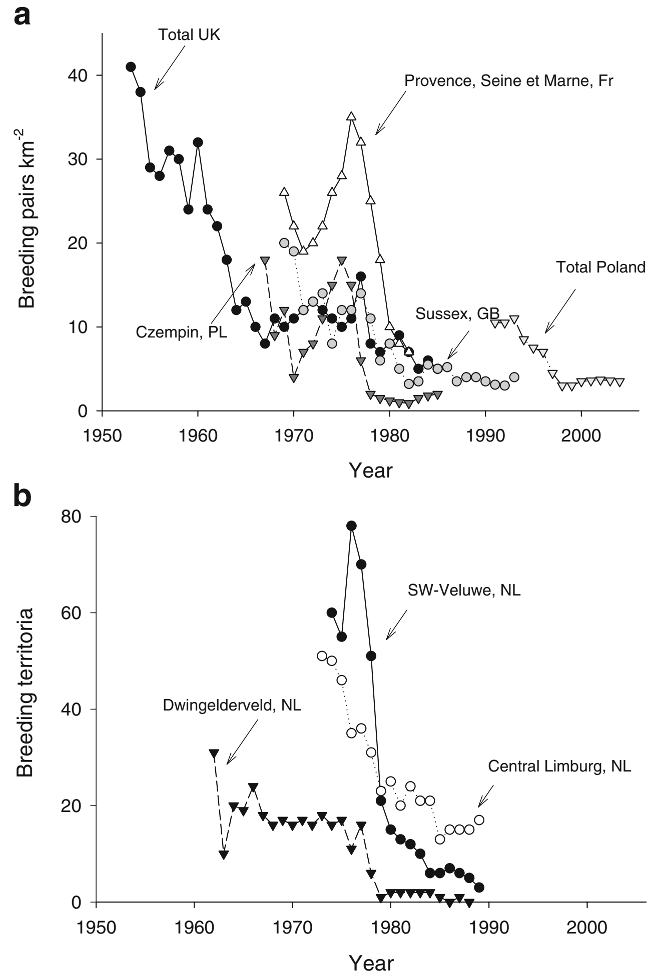

Fig. 1 **a** Population trends of grey partridge expressed as number of breeding pairs per square kilometre in the UK compared to different countries in continental Europe. Data originate from total UK (Potts 1986), Sussex in UK (Potts and Aebischer 1995), Czempin in Poland (Chlewski and Panek 1986), total Poland (Panek 2005) and the Provence and Seine et Marne in France (Birkan 1985). **b** Population trends of grey partridge expressed as number of breeding pairs in three different areas in the Netherlands. Data originate from Bijlsma (1990)

Population crash in 1950–1970

What caused the crash in grey partridge populations that has been observed in the UK in the period 1950–1970? In the

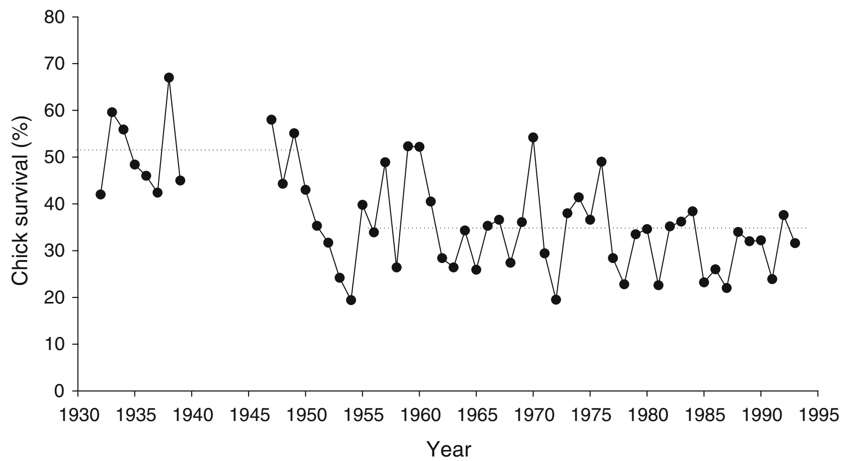

Fig. 2 Annual survival rates of grey partridge chicks from hatching to an age of 6 weeks. Survival has been determined on the basis of family size in August according to Potts (1986). Data from 1903 to 1932 originate from 'Great Witchingham', UK and data from 1933 to 1993 refer to data collected throughout the UK by the National Game Census. Data from Potts and Aebischer (1995)

period 1903–1950, before the population crash, average chick survival rate was 51%. In the subsequent period, chick survival rate dropped to less than 20% in only a few years time (Potts and Aebischer 1995). From 1955 until 1993, it remained at a constantly low level with an average of 33% (Fig. 2). A similar sudden decrease in chick survival rate has been observed in countries throughout Europe and marks the start of the population crash in all long-term monitored grey partridge population in Europe (Potts 1986).

One of the most important factors that caused the sudden drop in chick survival rate is a strong increase in pesticide use to prevent agricultural crop damage. These include insecticides, herbicides as well as fungicides. Whilst only 15% of the cereal fields were sprayed with herbicides in the 1950s, in less than 10 years time, this figure increased to more than 70% of the fields. Five years later, 1965, more than 90% of the fields were sprayed (Potts 1986). In the rest of Europe, a similar rise in pesticide use has been observed but started approximately 10 years later. The sudden drop in chick survival rate in this period coincides with the increased pesticide use (Potts 1986).

The increased pesticide use might have caused direct effects on partridges by poisoning birds, or indirect effects through killing their food. However, the reported number of cases that can be attributed to direct effects is relatively small, and indirect effects seem to play a much more important role (Potts 1986). The increased pesticide use indirectly reduced the diversity of weed species in agricultural areas. In the beginning of the century, on average, eight species of weed per square metre occurred in cereal fields in the UK, which decreased to less than three species per square metre in the 1980s (Potts 1970a, 1986). On the one hand, the disappearing weed species included preferred food plants for adult grey partridges, such as common chickweed (*Stellaria media*), knotweed (*Polygenum aviculare*), black bindweed (*Polygonum convolvulus*) and brittlestem hempnettle (*Galeopsis tetrahit*). On the other hand, it reduced the abundance of several insects that were associated with these weed species. These insects included preferred chick food, such as aphids, ground beetles (f.e. *Trechus quadristriatus*), leaf beetles (f.e. *Gastrophysa polygoni*) and sawfly larvae (*Dolerus* spp.; Potts 1986). Also other studies showed that especially indirect effects of increased pesticide use resulted in a decrease of grey partridge chick food availability (Moreby et al. 1994; Taylor et al. 2006) and for farmland birds in general (Moreby et al. 1994; Boatman et al. 2004). A high insect abundance is crucially important for chicks as survival rates during the first 3 weeks after hatching are highly dependent on it (Potts 1986). Recent studies showed that not only the abundance but also the quality of insects is important. Chicks, which have a diet composed of a high variety of nutritious invertebrates, have higher survival to the age of 6 weeks (Browne et al. 2006).

A second important factor explaining population decline in 1950–1970 is a decreasing habitat quality. Large-scale changes in the agricultural landscape occurred due to the intensification and mechanisation of agricultural practises. In the UK, the disappearance of hedgerows decreased the amount of suitable nesting sites (Potts 1986; Rands 1987). In continental Europe, field sizes increased resulting in smaller amount of weedy field borders and margins (Figala et al. 2001). This scaling-up in farming and the more efficient use of space strongly reduced the amount of unmanaged wasteland patches, which provided nesting cover and chick-rearing habitat (Rands 1982; Šálek et al. 2004; Wubbenhorst and Leuschner 2006), resulting in lower recruitment of grey partridges (Rands 1982). In central European countries, the management intensity and use of pesticides in agricultural areas can be lower than those in western European countries (Báldi and Faragó 2007). However, the large decline in grey partridge population also here for a large part seems to be related to habitat changes due to agricultural intensification and the abandonment of traditionally cattle-grazed pastures (Báldi and Faragó 2007).

Population decline after 1970

Potts and Aebischer (1995) showed that chick survival rate could not explain the continued population decline observed in the period 1968–1993 in Sussex, UK. Instead, the decreasing percentage of nests that successfully hatched, which is dependent on hen survival and clutch survival, best explained the observed trend. Several studies indicated that increased predation rates are responsible for this decreasing percentage of successful nests. As the amount of game keepers and managed game estates decreased strongly in the UK after 1970 (Potts 1986), not only grey partridge hunting bags decreased but also the intensity of predator control. This reduced predator control may explain the higher predation rates according to Potts and Aebischer (1995). Model simulations showed that restoring the population to the level that was observed before 1950 could only be accomplished by simultaneously increasing chick survival rate and reduce predation pressure (Potts 1986; Potts and Aebischer 1995).

Model simulations of long-term monitored populations in France also suggested that increased predation plays an important role in the population decline after 1970. After removing the effects of shooting from their demographic model, hen survival rate during first nesting attempt was the most important factor explaining variations in population growth rate observed in NW France (Bro et al. 2000). Predation was the main cause (70%) of death of hens during the breeding season in their study area (Bro et al. 2001). Although no causal relationships were shown, the authors suggested that increasing numbers of hen and marsh Harrier could have contributed to the decline of grey partridges in France (Bro et al. 2001), although in later studies they showed that currently this problem is restricted to certain areas (Bro et al. 2006). In line with the English and French studies, Panek (2005) showed that the population decline in the 1990s in Poland was related to a decrease in the percentage of successful nests, survival rate of adult birds and chick survival rate. Especially, the first two factors seem to be caused by an increased predation of incubating hens. The studies in the UK, France and Poland all point out that an increased predation seems to be an important factor causing the population decline of grey partridges in this period. Important to note in these studies is that hunting mortality (albeit sometimes strongly reduced) remained next to predation an important mortality factor. The mortality caused by hunting (35–39%) in some areas in the UK was more than double the losses caused by raptor predation (9.5–15%; Watson et al. 2007).

Grey partridges thus seem to have suffered from the decreasing amount of managed game estates as also the amount of predator-controlled areas decreased. On the one hand, grey partridges thus benefited from the management in these estates; however, on the other hand, several studies showed that hunting and related activities in these estates also negatively affect grey partridges. Releasing game birds such as ring-necked pheasants (*Phasianus colchicus*) and red-legged partridge (*Alectoris rufa*) on hunting estates can be harmful for grey partridges. Ring-necked pheasants and grey partridges share a common parasite, the caecal nematode *Heterakis gallinarum*. Whereas the infection with this nematode hardly affects pheasants, grey partridges that were infected showed lower body condition, which likely affected reproduction and survival rate (Tompkins et al. 2000b). Apparent competition between ring-necked pheasants and grey partridges, mediated via the caecal nematode, may be one cause of the recent decline in UK grey partridge numbers and may be hampering current efforts to re-establish and increase wild populations (Tompkins et al. 2001, 2000a). Releasing pheasants and red-legged partridges also leads to unsustainable heavy losses of grey partridges by shooting as they inadvertently become caught up in the drives of released gamebirds (Watson et al. 2007). As a result, grey partridge numbers decreased more on estates with game bird releasing compared to estates with no releasing (Aebischer and Ewald 2004). Annual shooting plans should be adjusted to total population size and young/adult ratios, and conservative hunting management can coincide with increasing grey partridge numbers (Pépin et al. 2008). However, as shooting in areas with large-scale releases of game birds (especially red-legged partridges) acts in a density-independent manner, overshooting may lead to local grey partridge extinction (Watson et al. 2007). Also de Leo et al. (2004) conclude that the hunt for grey partridges throughout European countries, although reduced in effort, may have contributed to the extinction of many sub-populations and is critically threatening remaining ones. However, due to the fact that most management action to increase grey partridge densities are carried out by hunting organisations, removing grey partridges from the quarry list may be counterproductive (Watson et al. 2007).

Changing causes of decline

The main causes explaining the decline of grey partridge populations have thus apparently changed through time. Before 1950, population size was critically dependent on one factor: chick survival rate. The subsequent crash in population size in 1950–1970 in the UK (and 1960–1980 in the rest of Europe) was the direct result of a steep drop in chick survival rate as a result of the decreasing chick food availability due to agricultural intensification (increased pesticide use and landscape alteration). One key factor determines in both periods the population level. In the subsequent period, at low population levels, not one but several factors are causing the continued decline in grey partridge numbers; a reduction of hen survival rate during incubation, reduction of percentage successful nests and reduction of winter survival (Bro et al. 2000; De Leo et al. 2004; Fig. 3). These factors seem to be related to an increased predation rate. Furthermore, in some areas, the shared parasite with pheasants and high shooting losses contributed to the decline of partridges.

Recovery of grey partridge populations

What can be done to restore grey partridge populations? Since several recent studies stress the importance of increased predation rates, there has been much attention to decrease the effects of predation. However, few studies have examined if predator control is really an effective management option. Exceptional is the study by Tapper et al. (1996) who showed that reducing predation rates by intensively controlling predators (fox, stoat, crows and magpies) increased the number of successful clutches and increased reproduction rate of grey partridges. During a 3-year period, the number of breeding pairs and autumn density showed a 2.6- and 3.5-fold increase, respectively, compared to a control site. The authors concluded that predator control is an effective conservation tool next to habitat management and reduced pesticide use. An important factor that should be taken into account in this study is that an intensive predator control took place in relatively small areas, and predators re-established after the hunting period. The question remains to be answered whether predator control is efficient and can be applicable at a large scale and at what costs (both economic and ecologic). Additionally, the study area used by Tapper et al. (1996) was characterised by a varied landscape with extensively used agricultural farmland. At the start of the experiment, grey partridge spring densities of 5–10 pairs/ km^2 were observed, which is within the range of densities found in good continental grey partridge areas in France and Poland (Bro et al. 2000; Panek 2005) but a factor 10 higher compared to breeding pair densities observed in other parts of Europe, for example in the Netherlands (Bijlsma et al. 2001). This indicates that habitat quality is better in the area where the experiment was carried out than in the Netherlands. The question is whether poor habitat conditions, such as in the Netherlands, allow a similar game increase by reducing predation rate.

Based on the causes of decline of grey partridge populations described in the previous section, predation only played a role when population levels had already dropped to low levels. Although this may be due to increased numbers of predators, it may also be due to the interacting effects of predation rate and landscape changes specially in populations with already low chick survival rates and thus recruitment rates. Habitat changes can influence predation rates in many ways, see Evans (2004) for an overview. Because habitat changes and changes in predation rates strongly interact, the real causes of decline of species can often not be attributed to one of the two factors. However, the main factor that caused the crash in population size was not related to changes in predation rate but to changes in chick feeding conditions determining chick survival rate. Therefore, to restore grey partridge population size to numbers observed before this crash, one should first of all improve habitat quality as this is the main cause of the population decline. The question

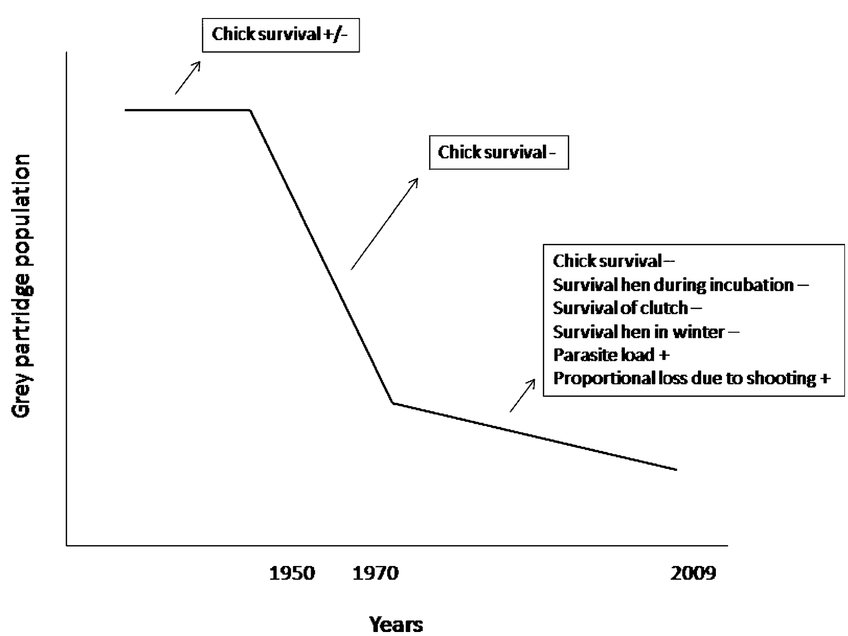

Fig. 3 Schematic presentation of population development of grey partridges in the UK. Three periods are indicated: stable high population before 1950, sharp declining numbers in 1950–1970 and continued decline after 1970. The main causes of decline have been indicated for each period. Per factor is indicated if it decreased (*minus signs*) or increased (*plus signs*). In the first two periods, one single key factor determines population size, whereas a number of factors cause the more recent continued decline (see text for further details)

whether habitat improvement should coincide with predator control to allow the recovery of low density populations (as in the Netherlands) still remains to be answered and needs further study. In contrast, at higher population levels, in areas which provide enough suitable nest and feeding habitat during summer and winter, high grey partridge densities can be maintained without predator control (Šálek et al. 2004). But in which ways can habitat quality be improved and how successful are restoration projects that improve habitat quality?

Improving farmland habitat

There are several possibilities to improve habitats in areas that have become less suitable for grey partridges. One of these is rotational set aside (RSA). The most widely adopted practise of RSA is to let fields naturally regenerate a vegetative cover in the absence of agrochemical inputs (Sotherton 1998). The natural weedy pioneer vegetation can offer food for several farmland birds (Sotherton 1998). Next to vegetable food, the availability of preferred insects for grey partridge chicks has been shown to increase more than 3-fold on RSA fields compared to conventional cereal fields (Moreby and Aebischer 1992). Pilot studies showed that these improved feeding conditions increased reproduction rate from on average 6.6 chicks per hen on conventional fields to 9.4 chicks per hen on RSA fields (Sotherton et al. 1998). However, without proper management, set-aside areas will change within 3 years to a grassy sward primarily consisting of biennials and perennials due to vegetation succession (Wilson 1992). These grassland-like habitats are of little value for grey partridges that seek the habitat structure, vegetation composition and invertebrate fauna provided by cereal fields (Sotherton 1998). However, small-scale unmanaged wasteland patches can be beneficial for grey partridges as they provide suitable nesting sites.

Next to natural regeneration, fields can be sown with seed mixtures to improve feeding conditions in winter and during brood-rearing. Mixtures based on kale (*Brassicae*) provide the best potential for winter crop on set aside. Seed-bearing crop such as quinoa (*Chenopodium quinoa*), millet (*Panicum effusum*), buckwheat (*Fagopyrum esculentum*) and sunflower (*Helianthus annuus*) can be added in these mixtures and also provide food for passerines. These mixtures can be left for the following year and will provide good brood-rearing cover in summer (Sotherton 1998). To improve brood-rearing habitat, mixtures based on cereals can be used to create insect-rich vegetation. Triticale and oats have performed well in trials on set aside in the UK (Sotherton 1998). Next to these species, linseed, mustard or other brassicas can be added. A worthwhile third component can be red clover (*Trifolium pratense*) to increase attractiveness to insects (Sotherton 1998).

Habitat management often involves strips at existing field boundaries. In this way, they can be most easily be integrated in agricultural practises, and they create a mosaic in the landscape. Grey partridges quickly profit from these improved habitats, and higher densities of grey partridges in comparison with conventional fields often occur (Bro et al. 2004; Buner et al. 2005). Therefore, habitat improvement is expected to enhance recovery of grey partridge populations. The 6-year study of Bro et al. (2004), in which these habitat management programmes were evaluated in France, showed that this is not always the case. In none of the areas, an increase in the number of breeding pairs was observed as a result of the habitat management, which mainly consisted of improving winter food availability. Winter survival rate even decreased in the areas with habitat management. This contradiction was explained by higher predation rates that seemed to occur in habitat management strips. Predators seemed to learn where grey partridges could easily be caught and the strips acted as an 'ecological trap'. The benefits of improved habitat were thus counteracted by increased predation rates. The lesson can be learned that instead of using linear elements it is better to create blocks of improved habitat, which are big enough to avoid an ecological trap. Sotherton (1998) mentions a minimal size of each block of 0.3 ha with a width of 20 m. Besides, grey partridges are territorial during the breeding season and each pair uses and area of 6–10 ha (Buner et al. 2005; Novoa et al. 2006) or smaller than 2 ha in areas with good habitat (Šálek et al. 2004). The creation of only a few blocks will then be beneficial for only a few individuals. Therefore, blocks of improved habitat should be scattered over a wider area to increase its capacity to benefit game and other wildlife (Sotherton 1998).

Improving conventional agriculture

Habitat management should not only focus on areas outside conventional agricultural fields as large progress can also be made within that realm. Simple measures like not ploughing fields in autumn and leaving the stubbles on cereal fields can already improve winter food availability (Potts 1970b; Hotker et al. 2004). However, most important is to improve chick food availability by decreasing the negative impact of pesticide use. Most ideal, the pesticide use should be stopped completely as is the case in organic farming. In organic farming, no pesticides, herbicides or inorganic fertilisers are used. Organic farming on cereals fields leads to a higher weed diversity and insect diversity (including preferred insects) in comparison with conventional fields (Moreby et al. 1994; Moreby and Sotherton 1997). Several bird species seem to profit from these elevated food supplies and are observed in higher densities on organic farms compared to conventional farms (Chamberlain et al. 1999; Bengtsson et al. 2005; Fuller et al. 2005). Especially, organic farming in intensive large-scale agricultural areas seems to lead to positive effects of wildlife (Bengtsson et al. 2005). Also grey partridges seem to profit from a complete cessation of pesticide use (Henderson et al. 2009).

Since complete cessation of pesticide use will hardly be an option in practise, and organic farming is more likely to occur in areas with lower agricultural potential (Gabriel et al. 2009) the reduced use and a more selective use of pesticides can already significantly contribute to improve feeding conditions for grey partridge chicks (Moreby and Southway 1999). Many pesticides reduce the abundance of harmless insects that are not aimed at (Moreby et al. 1997, 2001). In the UK, higher chick survival rates have been observed in cereal fields where selective pesticides were used, aimed only at aphids and problem weeds, compared to fully sprayed fields (Rands 1985). One way to reduce pesticide use is by means of 'conservation headlands', which consist of a strip of 6 to 12 m forming the outer margin of the crop, cropped with cereals but managed with limited insecticides (autumn cereals only) or no insecticides (spring cereals) and with reduced inputs of herbicides (Vickery et al. 2002). In this way, establishment of weed species and the insects in these unsprayed field margins is stimulated (Hassall et al. 1992). The improved insect availability on these conservation headlands increases the chick survival rate (Potts 1986; Rands 1986; Sotherton et al. 1993) and the number of grey partridge breeding pairs (Chiverton 1999) compared to fully sprayed cereal fields. Because of the yearly rotation of the soil and the relatively low plant diversity (by ploughing and sowing of cereals), the insect diversity in conservation headlands is not as high as in set-aside fields (Hassall et al. 1992), and it does not create the landscape mosaic that is associated with organic agriculture. However, the big advantage of this system is that it can be relatively easily introduced over a wide geographical scale and can be integrated with whole-field management practises (de Snoo 1999; Vickery et al. 2002).

Combination of factors

Since nowadays not a single key factor is causing the continued declining numbers of grey partridge, recovery management options should focus on several factors and combine above-mentioned options. Management should aim at simultaneously improving adult survival, winter food supply and nest site cover (see also Bro et al. 2000; De Leo et al. 2004). However, these measures will only be successful when chick food supply will be enhanced first as this crucially determines chick survival rates. Improving the chick-rearing habitat is therefore crucially important and should deserve highest priority (Aebischer and Ewald 2004). Demonstration projects in the UK where these three factors were improved in agricultural areas, including predator control, proved that numbers of grey partridges could be restored (Boatman and Brockless 1998; Aebischer and Ewald 2004). High predator numbers potentially could prevent the recovery when habitat requirements are met. However, also without predator control grey partridge populations could be restored. Aebischer and Ewald 2004 calculated that 5% of the arable land should be created as insect-rich chick habitat in combination with 6.9 km/km^2 of nesting cover to stabilise the UK population in typical agricultural areas. These estimates relate to a situation without predation control. With predation control, less suitable nesting site would be needed to reach similar results. Illustrative in this context is the study of Henderson et al. (2009) who measured in a 6-year experimental study the response of bird populations to combinations of mixed cropping and low pesticide regimes associated with a commercial cropping rotation. After 3 years, they observed a rapid and sustained population increase of a wide range of bird species, typical for arable farmland, including a 300% increase of grey partridges. The study demonstrated the possibility to significantly increase the carrying capacity of modern, commercially viable arable farmland for birds.

Conclusions

The strong population decline of the grey partridge in 1950–1970 in the UK and 1960–1980 in the rest of Europe has been caused by a sharp drop in chick survival rate caused by habitat deterioration. Management options to restore populations should, therefore, above all improve chick-rearing habitat. Next to that, other factors are important such as clutch survival and hen survival during incubation and winter. Management should therefore focus on restoring: (1) insect-rich chick habitat, (2) seed-rich winter habitat and (3) suitable nesting cover. Consideration whether predator control is also needed to restore low grey partridge numbers should not divert from the main factor needed to restore the population, i.e., habitat improvement. There are ample options to improve these habitats. We should not focus on the creation of islands of ideal grey partridge habitat, which are sensitive for the effects of predation, but try to integrate conservation with the existing agricultural practises. Next to fields specially created to increase insect food supply or winter food, conventional agricultural fields should be improved by crop diversification and reduction and more selective pesticide use. Unsprayed field margins are a practical solution that can be introduced on a large scale. Only with a management that is integrated in the conventional agriculture can large-scale habitat improvements be achieved that can turn the tide for the declining grey partridge population.

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