June 2010

Agriculture and Biodiversity

ELO is supported by the European Commission Directorate General Environment under the LIFE+ programme Operating Grant Agreement n° 07.0307/2009/SI2.535265SUB/A1

Acknowledgements

This paper is the result of a fruitful collaboration between 4 key stakeholders who work on a daily basis in the field of Agriculture and Biodiversity throughout Europe. This includes both the policy related as well as the scientific aspects of the two subjects. The partners are;

- ***European Landowners Organization (ELO)***
- ***European Crop Protection Association (ECPA)***
- ***RIFCon GmbH***
- ***E-Sycon***

The main authors were Dr Michael Riffel (RIFCon GmbH), Dr Christian Dietzen (RIFCon GmbH), Prof Christoph Künast (E-SyCon), Peter Day (ECPA), Jethro Schiansky (ELO), and they were supported by many others for editing and administration.

Preface

You might be wondering why both ELO representing land managers and the ECPA representing the crop protection industry have produced this paper on Agriculture and Biodiversity? Simply because the topic is a key question for the future of agriculture: are we capable of making a sufficient contribution to global food security whilst protecting the environment and halting the global loss of biodiversity by 2010 and beyond? Is this a realistic target? We believe that it has to be.

For decades producers have been attempting to balance this difficult equation: high quality production at the lowest possible price for consumers, while providing environmental services. This means producing environment not only as a by-product of agriculture but also as a concrete service according to citizens' current demand. After all, biodiversity and other ecosystem services produced by land managers have a price attached to them. As the best indicator for biodiversity we have available, we analyse bird population trends alongside the evolution of agriculture.

As land managers, we firmly believe that the various elements of this delicate equation can be balanced, via best practices, new techniques and new technologies, research and training, whilst bearing in mind the additional challenge of our changing climate.

These are reasons to hope and believe that land managers can adjust production towards practices that are more favourable for biodiversity, without sacrificing food safety and food security. To achieve this, producers must have the right tools available for protecting crops.

This paper acts as the first step of a long-term project that ELO and ECPA have launched, aimed at bringing together a majority of stakeholders looking for concrete solutions that will promote biodiversity.

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Executive Summary

Biodiversity is increasingly seen as a key objective of economic, social and cultural development. Governments and civil society have now laid the foundations for biodiversity protection, but increased involvement of the agricultural sector and other business sectors is urgently needed in order to cope with the scale of the task of achieving Europe's aim of halting the loss of biodiversity by 2010 and beyond.

Modern agricultural techniques have had a major impact on biodiversity in the past. However, it is not unreasonable to suggest that this has been one of the social choices that were made in response to the economic, environmental and political circumstances of the time. In addition, the technical and structural changes brought about by the mechanical, chemical and biological revolutions in farming during the post war period led to several decades of government policy, which in some Member States encouraged farmers to drain wetlands and remove hedges, with a detrimental effect on biodiversity in those areas. But times have changed, and with them, technology and policies. Farmers, who work on the 'front line' with nature and the environment, are more than aware that protection of ecosystems will be of benefit to them and others in the long-term. They appreciate that biodiversity provides many ecological "services", such as pollination, humification, and the beneficial soil organisms which are essential for productive agriculture.

The interactions between agriculture and biodiversity in Europe are highly complex. However, with the right approach, modern agriculture and biodiversity protection are compatible. Modern farming practices have and will continue to evolve in order to facilitate nature conservation strategies. The importance of finding a balance between the two, in the light of food supply and environmental security challenges is paramount.

The definition of "biodiversity" given at the Rio Conference in 1992 leaves space for interpretation. Undoubtedly, the vast variety of animals and plants in Europe including species, populations and ecosystems, makes it impossible to quantify "biodiversity" as an entity. Hence we chose birds as the main indicator species for biodiversity.

Agricultural landscapes provide a variety of habitats for birds. Some species have flourished as a result of farming conditions in the past and today, whilst many have diminished. This shows that population trends are highly dynamic which is indeed an intrinsic property of biodiversity in agricultural landscapes. Whilst reasons for bird population changes are highly complex, key factors can often be specified, such as habitat availability, predation, climate conditions or changes in farming practices.

It is certainly true that agricultural land use practices in the EU have a major impact on bird population trends.

Case studies show that modern agriculture and bird protection can and should be compatible. Species adapt to a given environment. Where there is a desire to protect or increase numbers of specific organisms or species communities in a given area, this can invariably be achieved by targeted management practices, which inevitably impose costs and the requirement of resources on society. It can be concluded that the main characteristics of effective programmes include consistency of protection goals, economic viability for farmers, availability of resources, and continuity of resource availability throughout a given programme. This helps to achieve sustainability of the measures taken as well as a balanced benefit for both farming and biodiversity protection.

It is essential that the importance of biodiversity protection with respect to agriculture is realised and that policies take account of developing socio-economic factors, such as increased food prices or competition for land between "food, feed, and fuel". In addition, macro ecological factors – such as climate change and invasive species– which also have a huge impact on species communities, must be accounted for. If the right balance is struck, then technologically advanced agriculture will be able to meet societies' expectations, and manageable, sustainable concepts for biodiversity protection can be achieved.

1 INTRODUCTION

1.1 Purpose of the document

In Europe, agriculture dates back several millennia. Over time, agricultural practices have inevitably influenced the original plant and animal diversity of the continent.

This agricultural development is a continuously evolving process as new agricultural technologies (e.g. mechanical soil treatment or synthetic fertilizers), new socioeconomic pressures (e.g. development of global markets), and new macro-ecological conditions (e.g. climate change or the introduction of invasive species) have emerged. This will continue to be the case in the future.

Agriculture and nature conservation are often described as being in conflict. In particular, "modern" agriculture (which takes advantage of new technologies) is often viewed as causing a reduction in biodiversity. However, this is not the whole story. The complexity of the interactions between farming practices and biodiversity as well as other factors affecting biodiversity in Europe must all be carefully considered.
The aim of this document is to show that:

- Today's agricultural needs and biodiversity protection in Europe are compatible
- Technologically advanced farming practices have and should continue to evolve in order to facilitate nature conservation strategies
- Biodiversity is not a static entity – it is affected by a wide range of factors which must all be considered when deciding future policy
- A careful balance must be struck which allows for continued agricultural development and sufficient production, whilst maintaining biodiversity. Unless ways are found for society to pay for biodiversity it will continue to be a secondary consideration to 'market demands' on land use.

1.2 Facts and Figures – Agriculture and Biodiversity

The basic definitions of agriculture and biodiversity, which will be used in this document, are as follows:

Agriculture is the utilization of natural resource systems to produce commodities which maintain life, including food, fibre, forest products, horticultural crops, and their related services.

Source: Natural Research Council

Biodiversity is the variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part: this includes diversity within species, between species and ecosystems.

Source: United Nations Conference on Environment and Development, Rio de Janeiro, June 3 to June 14, 1992

This 'Rio' definition of biodiversity is widely used and quoted in the literature. The scope of this definition is holistic and it includes the variability in all forms of life. The three generally recognized levels of biodiversity are[3]:

- Genetic diversity - the variety of genetic building blocks found among individual representatives of a species,
- Species diversity - the variety of living organisms found in a particular place, and
- Ecosystem diversity - the variety of species and ecological functions and processes, both their kind and number, that occur in different physical settings.

This makes "biodiversity" scientifically complex because of the high number of organisms and all the possible interactions between them. However, any comprehensive strategy for agriculture must take all levels of biodiversity into account.

In the EU (EU-25), agricultural land covers some 160 million ha, equivalent to over 45% of the total land[4]. This area provides habitat for a vast diversity of organisms. Europe is estimated to have more than 215,000 animal and plant species[5] and Germany alone has some 48,000 animal species. Globally, 1.7 – 1.8 million species are described today, but experts estimate that a total of between 10-100 million species exist.

Many of these species inhabit the diverse range of European agricultural landscapes (illustrated in Figure 1), most of which are influenced by their human land-use practices. Agriculture therefore plays an important role in shaping European biodiversity due to;

- The space which agriculture occupies (almost half of European land is used for agriculture).
- The influence of different farming practices on agricultural landscapes.

Figure 1 ***Diversity in European agricultural land: from highly intensive agriculture to "element-rich" landscapes***

Photos: Michael Riffel

The holistic Rio definition of "biodiversity" includes the variation of life at all levels of biological organization. It is not a separate measurable entity, and any comprehensive biodiversity strategy for agriculture must take all levels of biodiversity into account (genetic, species and ecosystem diversity).

1.3 Agricultural development in the EU

Today's European agricultural landscapes and the species inhabiting them are the result of long-term historic developments. Over time animal and plant species from neighboring biogeographical areas (e.g. Asian steppes) immigrated, new species were actively introduced by humans and new crop and livestock varieties were bred. Table 1 is a brief summary of key events affecting the long-term development of European agricultural landscapes.

Table 1 Selected factors in the development of agriculture in Europe.

When ?	What ?
Prehistory	• Settled ways of living. • "Neolithic revolution" based on cultivation of wild plants and animals. • Deforestation started.
Roman Empire	• Advanced political system with sophisticated distribution and processing system for agricultural goods.
Middle Ages	• Improved technologies, such as soil treatments. • Alteration of political and social systems leading to diverse farming systems, such as "three field crop rotation". • 1492: European contact with America: new crops and livestock available, new plant and animal species start to migrate to Europe.
19th Century	• Widespread nutrient-poor agricultural ecosystems as a result of overexploitation. • Agricultural sciences develop a multitude of new farming practices and crop varieties.
20th Century	• Application of the internal combustion engine. • Haber-Bosch 1914: Synthetic fertilizers available. Development of plant protection products. • Application of plant breeding. • "Green Revolution" leading to a steep increase of quality and quantity of agricultural goods. • Land reform and consolidation in many parts of the EU. • Steep increase of human population. • Identification of DNA and genomics leading to scientific developments.
21st Century	• Globalization of markets for agricultural goods. • Higher prices for agricultural goods. • Competition for land between "food, feed and fuel", notably biofuels issues.
The Future	• ***See Section 2. GLOBAL TRENDS***

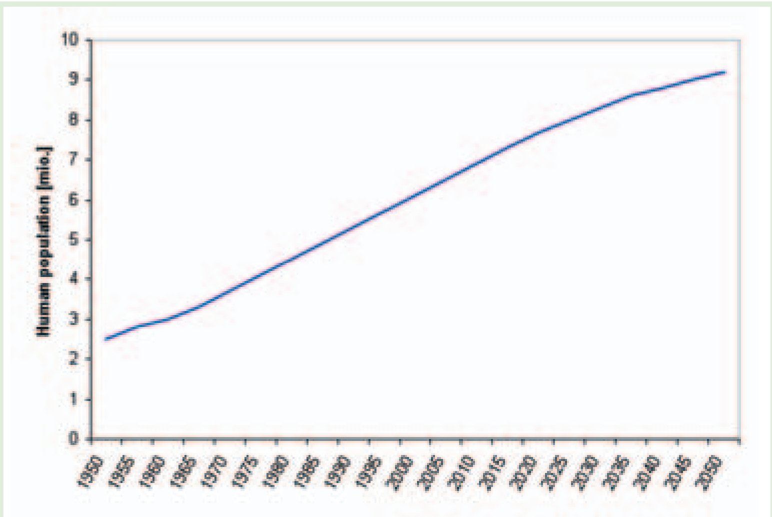
Agriculture in Europe has a long history. A multitude of farming practices have been developed and implemented. The changes in practices have had consequences on the species inhabiting these environments. Agriculture will continue to develop and evolve in both foreseeable and unforeseeable ways. What is certain is that future global trends affecting agriculture both directly and indirectly will have a huge impact both on the way Europe farms and also what Europe expects the agricultural sector to provide.

2 GLOBAL TRENDS

There is no doubt that in the future agriculture will be faced with certain foreseeable global challenges. According to the OECD these include:

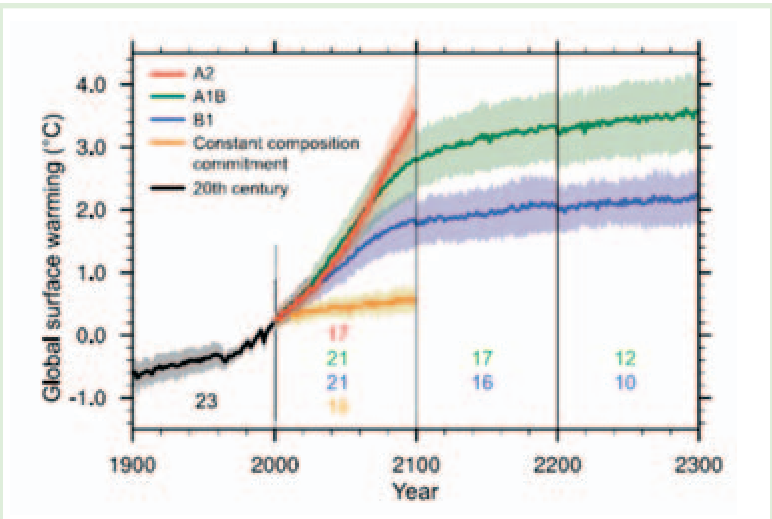
- Increased human population *(Figure 2)*
- Increased wealth in several countries of the world and demand for "Western" diets (e.g. China)
- Global climate change *(Figure 3)*
- Highly volatile prices for agricultural goods
- Competition for land between "food, feed, and fuel"

Figure 2 Global human population



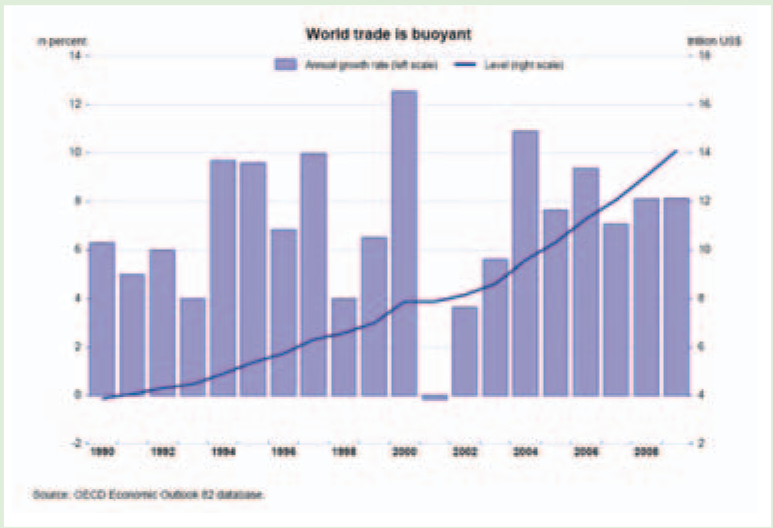
Development of human population since 1950 and expected growth until 2050 (United Nations Population Programme 2007). Much of this expansion and its associated prosperity were aided by significant increases in agricultural productivity based around the use of improved seeds, the widespread use of agricultural chemicals, the development of modern farm machinery and appropriate transportation systems[1].

Figure 3 Global climate change



Expected global surface warming according to different models as calculated by the IPCC 4th assessment report on climate change (2007).
There is a great deal of concern over the possible effects of global climate change on agricultural production. Projected effects of global climate change on world agriculture are dependent on region and are expected to be modulated by a wide range of socio-economic responses[6].

Figure 4 Development of global markets



Development of global markets (OECD database). The expansion of global markets and trade liberalisation tend to have a homogenizing effect on agricultural biodiversity by standardising food production and consumption.

These challenges will have direct and indirect impacts on EU farming practices and will thus have implications for the biodiversity in farmland.

Any changes in practices must take account of the current food and environmental security challenges. Europe is facing highly volatile prices for agricultural goods. Both structural and temporary factors can explain this, as highlighted by the Commission . These are notably the rise in demand of certain foods, the rise of energy prices and thus the cost of inputs, the alternative market outlets such as biofuels, the slowing down of the growth of some yields, and climate change. In order to mitigate those effects in both the short- and long-term, action must be taken. This is particularly true in the context of a growing population (projected to rise to about 9 billion by 2050) and thus a growing food demand. In particular, EU farming policy and thus the Common Agricultural Policy (CAP) must enable farmers to maximize their production in order to meet growing food demands. As the human population is increasing, agriculture needs to respond to the growing demand for food without leading to a growing need for land.

On the other hand, Europe is facing environmental challenges. Maximizing food production should not come at the cost of environmental degradation. In addition, agriculture must respond to the new challenges brought about by climate change and societal demand. Climate Change will definitively impact crop production. According to a recent FAO report on climate change and its implications for food safety , climate change is likely to reduce yields and/or damage crops. It will also advantage many pest populations, increasing fungi, diseases and insects.

Therefore all actions taken on biodiversity and agriculture must not only ensure compatibility with one another but also take into account the future challenges faced by Europe. The best way to achieve this is to choose methods enabling high yielding crops on a limited surface whilst protecting biodiversity. Using technologically advanced agricultural techniques is the key to limiting the expansion of agricultural land (see section 4.4) and therefore to protecting biodiversity. This will also enable Europe to meet its food and environmental security challenges.

3 LEGISLATION AND POLICY FRAMEWORK

3.1.1 Political commitments

The UN Convention on Biological Diversity (CBD) was adopted at the Rio de Janeiro Earth Summit (Conference on Environment and Development) in 1992, which committed governments to develop national strategies for the conservation and sustainable use of biological diversity.

European heads of State agreed at the 2001 summit in Gothenburg, *"to halt the decline of biodiversity* [in the EU] *by 2010"* and to *"restore habitats and natural systems"*. These commitments were reconfirmed in May 2006, in the European Commission's Communication on *"Halting the loss of biodiversity by 2010"* [9]. The communication highlighted two particular threats to EU biodiversity: (1) ill-considered land use and development, and (2) the impact of climate change.

In view of the International Conference on Biodiversity in Nagoya Japan on October 2010, the European Commission released a new Communication in January 2010[10] and proposed 4 options for a future target . Since the 15th of March, the European Council agreed on 'option 4'committing "To halt the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, restore them in so far as feasible, while stepping up the EU contribution to averting global biodiversity loss". Furthermore, the European Commission will present an EU biodiversity strategy by the end of 2010.

3.1.2 Policy framework

The EU policy framework to implement the CBD was established in the Commission Communication on a European Biodiversity Strategy adopted in 1998. The strategy contains four biodiversity action plans for (1) conservation of natural resources, (2) agriculture, (3) fisheries, and (4) economic and development cooperation outside Europe. Most Member States have also developed, or are in the process of developing, such national strategies and/or action plans.

A key component of the action plan for conservation of natural resources is the creation of a network of sites of high ecological value — Natura 2000. The network consists of:
- Special protection areas (SPAs) to conserve the 194 bird species listed in Annex I of the Birds Directive (79/409/EEC) as well as migratory birds; and
- Special areas of conservation (SACs) to conserve the 273 habitat types, 200 animal and 724 plant species listed under the Habitats Directive (92/43/EEC).

The network currently covers around 20 % of the territory of the EU-27.

Outside of Natura 2000 sites, EU policy focuses on integrating biodiversity requirements into other community legislation including: the 6th Environment Action Programme (2002-2012), Sustainable Development Strategy, Common Agricultural Policy and Rural Development Regulation.

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[10] *COM(2010) 4 final, 19.1.2010 presented relative to their 1980 status.*

3.1.3 Biodiversity Action Plan for Agriculture

The Biodiversity Action Plan for Agriculture[3] was adopted in 2001 and aims to integrate biodiversity considerations into farming practices. A large part of the plan is devoted to the implementing agri-environmental measures, promoting good farming practice and supporting less favoured areas and practices at risk of abandonment. The priorities of the plan are:

- Ensuring the development of current intensive farming practices towards the achievement of a reasonable or rational degree of intensification.
- Maintaining an economically viable and socially acceptable agricultural activity, by targeted and tailored measures aiming at safeguarding biodiversity, in particular in biodiversity-rich regions where such activity has been weakened.
- Using agri-environmental measures for the conservation and sustainable use of biodiversity:
- Ensuring that an ecological infrastructure exists throughout the area.
- Supporting specific measures related to the use of genetic resources, to the maintenance of local, traditional and rustic breeds and varieties and the diversity of varieties used in agriculture.
- Introducing specific measures for encouraging the marketing of species and varieties that are naturally adapted to the local and regional conditions.

3.1.4 Common Agricultural Policy (CAP)

The Common Agricultural Policy (CAP) ensures the promotion of sustainable agriculture in a global environment. The core objectives of CAP were to[10]

- Provide healthy and safe food at fair prices for consumers
- Ensure a reasonable standard of living for farmers
- Preserve rural heritage

The recent CAP reforms and adoption of the new Rural Development Regulation have been used to incorporate environmental and societal considerations into agricultural policy. CAP farm payments have been decoupled from production and farmers are now required to meet a minimum set of environmental standards (compulsory cross-compliance) specified at Member State level. Under the rural development policy, support is provided for the introduction of agri-environmental measures (those going beyond the usual good farming practice) and also to preserve certain traditional farming practices.

> The EU political commitment and policy framework for biodiversity is in place. The European Biodiversity Strategy was adopted in 1998. It includes 4 action plans, one of which is for Agriculture. EU policy focuses largely on integrating biodiversity considerations into community legislation, such as the Common Agricultural Policy.

4 AGRICULTURE AND BIODIVERSITY

4.1 Agriculture needs biodiversity

Maintaining biodiversity is essential to sustain the ecological functions and processes which ensure the fertility and productivity of agricultural ecosystems. The diversity among living organisms which provide these functions has been termed "functional biodiversity"[11], and represents an important contribution to biodiversity by agriculture. Sustaining functional biodiversity ensures:

- Maintenance of soil structure and function
- Maintenance of soil fertility ***(Figure 5)***
- Crop pollination ***(Figure 6)***
- Prevention of soil erosion
- Nutrient cycling (including waste decomposition)
- Control of water movement and distribution (e.g. run-off)

All these processes are maintained through a complex relationship between the numerous organisms (including soil microbiota, insects, bacteria, plants and fungi) and their interaction with a variety of abiotic factors (such as light, temperature, rainfall and soil physio-chemical conditions).

Figure 5 Biodiversity under a footprint: a vast variety of soil inhabiting organisms contribute to soil fertility

Figure 6 Honeybees are the main pollinators for plants

Photos: Michael Riffel

Most of the organisms which constitute functional biodiversity are small and inconspicuous. However, quantitatively, they represent by far the majority of diversity of all organic life. This highlights that biodiversity conservation must consider all levels of biodiversity (genetic, species, ecosystem) and not focus solely on individual attractive, 'charismatic' species which may actually detract from the more fundamental elements which provide the basis for sustainability in agriculture.

Maintaining biodiversity is essential to sustain the ecological functions which ensure the fertility and productivity of agricultural ecosystems. Quantitatively, the small and inconspicuous organisms, such as soil microbiota and insects, make up the majority of biodiversity. Biodiversity conservation should consider all three levels of biodiversity (genetic, species, ecosystem diversity) and not focus exclusively on individual species.

4.2 Agricultural species are part of biodiversity

The maintenance of genetic diversity of domesticated animal and plant species is important to enable farmers and scientists to select or develop new livestock breeds and plant cultivars. Conserving this variety of species is relevant to biodiversity management and is important for:

- Producing higher yields
- Resisting stress, pests, or diseases
- Thriving under local conditions

Data collected by the UN Food and Agriculture Organization (FAO) and other organizations from over 170 countries suggests that domesticated animal varieties exceed 6,300 breeds of 30 mammalian and bird species: these include cattle, goats, sheep, buffalo, yaks, pigs, horses, rabbits, chicken, turkeys, ducks, geese, pigeons[12]. New varieties and cultivars are continually being developed in order to meet the requirements of agriculture.

Figure 7 **A relatively low number of wild origin species led to a broad variety of strains and breeds used in agriculture.**

Photos: Michael Riffel

The wide variety of domesticated plant and animal species also constitute biodiversity.

4.3 Agriculture benefits biodiversity

It is surprising to note that the evolution of European agriculture has actually enriched biodiversity. Historically, agriculture has resulted in the conversion of a relatively homogeneous vegetation (oak or beech woodland in much of central Europe, *Figure 8*) into a heterogeneous 'mosaic' of cultivated fields and boundaries providing a range of ecosystems and habitat types. Accordingly, many plant and animal species are now dependent on agriculture and its variety of farming practices; without them many species would not exist in major parts of Europe *(Figure 9)*.

Figure 8
Beech forests are the original vegetation in many central European areas.

Photo: Carsten Wagner

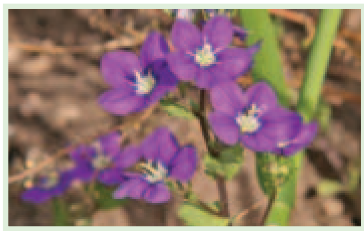
The abandonment of agricultural land and cessation of certain agricultural practices can be as a much a threat to biodiversity as the removal of certain habitat types (e.g. wetlands). For example the diversity of flora in open grasslands and alpine meadows are preserved by sheep or cattle pasturage, without which these areas would quickly revert to less biodiversity rich scrub vegetation. Political and financial support and close collaboration with farmers are required to help sustain these practices (see section 4).

Figure 9 **Examples of bird and plant species which are promoted by agriculture**

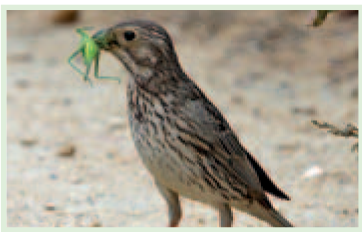
Skylark *(Alauda arvensis)*

Cornflower *(Centaurea acyanus)*

Yellow wagtail *(Motacilla flava)*



Venus-looking glass *(Legousia speculum-veneris)*



Corn bunting *(Miliaria calandra)*

Corncockle *(Agrostemma githago)*

Photos: Michael Riffel, Carsten Wagner and Lurii Konoval 2010 Used under license from Shutterstock.com

The evolution of agriculture has enriched biodiversity in Europe. Agriculture creates a 'mosaic' of ecosystems and habitat types supporting many plant and animal species. Abandonment of agriculture and cessation of certain agricultural practices can be a major threat to biodiversity. Continued support must be provided to sustain these practices.

4.4 Modern agriculture can aid biodiversity conservation

On a global scale, the steady increase of land used for agriculture is seen by many authors [13, 14, 15, 16] as a significant threat to biodiversity. However, the widespread use of mechanised farm machinery, the development of high yield crops, the application of mineral fertilisers and crop protection technologies have all been instrumental in helping to minimise expanding land use. Table 2 Illustrates that despite the steadily increasing global population, the amount of agricultural land needed to feed this population has not increased proportionally. By increasing yields on existing agricultural land, modern agricultural technologies should be viewed as making a significant contribution to biodiversity conservation[13] by leaving more land for conservation purposes than there would otherwise be [16, 17].

Figure 10 Modern agriculture helps minimise land use

Photo: Parnick 2010 Used under license from Shutterstock.com

Table 2 Development of global cropland in relation to human population development since 1700 (adapted from [13, 18]).

Year	Human population [Billion]	Global cropland [Mha]
1700	0.6	270
1961	3.1	1280
1993	5.5	1403
2000	6.1	1400
2005	6.5	1421
Increase (1961-2005) [%]	**+110**	**+11**

Table 3 **Two scenarios in the development of global cropland in relation to human population increase until 2050 (adapted from [13, 19]).**

Year	**Human population** [Billion]	**Global cropland** *without increased productivity (maintained at 1993 level)* [Mha]	*with increased productivity at a rate of 1.5% per year* [Mha]
1993	5.5	1450	1450
2050	9.2	2898	1240
Change [%]	**+67**	**+100**	**-14**

The two scenarios contained in *Table 3* also illustrate that in the foreseeable future an increased human population will need significantly more agricultural production. Increased productivity on the existing agricultural land is therefore essential for limiting expanding land use. This need has been highlighted in the European Commission's recent communication on deforestation, climate change and biodiversity[20] where they mentioned that:

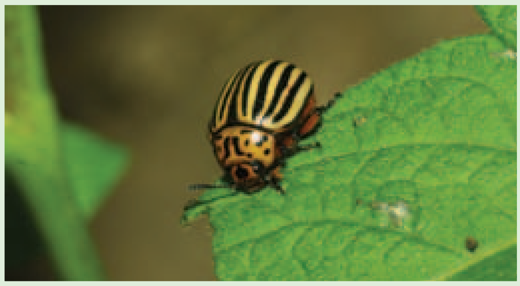
"…There are linkages between demand for agricultural commodities and pressures on land use. There is also a tension between the need to increase food production and the need to halt deforestation. Agricultural production should be increased without further deforestation. This requires substantial investment to increase yields on existing farmland. Stepping up agricultural research to enhance agricultural productivity growth in developing countries in a sustainable manner should be pursued…"

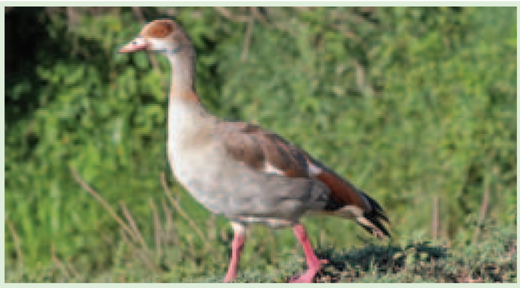
Modern agricultural technologies increase yields on existing agricultural land. They therefore make a significant contribution to biodiversity conservation by limiting the need to expand agricultural land and by allowing natural habitat to be maintained for conservation purposes.

4.5 Biodiversity is in the eye of the beholder

Under the Rio definition *(section 1)*, biodiversity includes the variety of all forms of life, all species, their interaction, and the variability among them. In reality however, different stakeholders have differing views on the subject, which is understandable considering their legitimate interests. From the farmers' perspective, crops and livestock require care and protection, pest insects *(e.g. Colorado Beetle, Figure 11a*) and diseases need control. From the nature conservancy standpoint, endangered or protected species *(e.g. European Roller, Figure 11b)* are the most important part of biodiversity and introduced, immigrant *(e.g. Egyptian Goose, Figure 11c)* and alien species are often viewed critically. From the general public's point of view, attractive species are of most interest and the multitude of small, inconspicuous organisms are usually overlooked. However, all these organisms constitute biodiversity and must be considered by policy makers.

Figure 11 Different organisms under the perspective of biodiversity

(a)

(b)

(c)


Photos: Christian Wolf, Michael Riffel and Mircea Bezergheanu 2010 Used under license from Shutterstock.com

Despite the holistic "Rio" definition of biodiversity, elements of biodiversity may be judged differently by different stakeholders.

5 BIRD POPULATIONS IN EUROPEAN AGRICULTURAL LANDS

5.1 Why focus on birds?

The complexity of interactions and the high number of species in most ecosystems makes it extremely difficult to measure biodiversity as a whole *(section 1)*. However, birds can be a useful *indicator* of biodiversity in agricultural land [21], [22].

The advantages of using birds to monitor changes in biodiversity in agricultural lands are that:
- Their biology and life-histories are well understood.
- They occupy the wide range of habitats supported by agriculture and in broad geographical areas. Many individual species are specialised in their requirements and have relatively narrow distributions.
- The abundance of plant and insect species on farmland affects the availability of food for birds.
- They are mobile and rapidly responsive to environmental challenge and change.
- There are enough easily identifiable species which are normally present to indicate meaningful and significant patterns and changes.
- There are a large number of highly skilled amateur and professional individuals that have produced a wealth of monitoring data on birds across a number of European countries.

The European Bird Census Council (EBCC) contains one of the most inclusive lists of farmland birds. It includes 33 species, listed in Table 4.

Table 4 European farmland bird species according to the EBCC

Species	Habitat category[a)]	EBCC population trend[b)]	IUCN Red List[c)]	Species	Habitat category[a)]	EBCC population trend[b)]	IUCN Red List[c)]
Skylark *(Alauda arvensis)*	field	moderate decline	LC	Calandra lark *(Melanocorypha calandra)*	field	moderate decline	LC
Tawny pipit *(Anthus campestris)*	edge/bush	steep decline	LC	Corn bunting *(Miliaria calandra)*	field	moderate decline	LC
Meadow pipit *(Anthus pratensis)*	field	moderate decline	LC	Yellow wagtail *(Motacilla flava)*	field	moderate decline	LC
Short-toed lark *(Calandrella brachydactyla)*	field	uncertain	LC	Black-eared wheatear *(Oenanthe hispanica)*	farmyard	stable	LC
Linnet *(Carduelis cannabina)*	farmyard	moderate decline	LC	Tree sparrow *(Passer montanus)*	farmyard	moderate decline	LC
White stork *(Ciconia ciconia)*	farmyard	uncertain	LC	Grey partridge *(Perdix perdix)*	field	steep decline	LC
Rook *(Corvus frugilegus)*	edge/bush	moderate increase	LC	Rock sparrow *(Petronia petronia)*	farmyard	moderate increase	LC
Cirl bunting *(Emberiza cirlus)*	edge/bush	moderate increase	LC	Whinchat *(Saxicola rubetra)*	edge/bush	moderate decline	LC
Yellowhammer *(Emberiza citrinella)*	edge/bush	moderate decline	LC	Stonechat *(Saxicola torquata)*	edge/bush	uncertain	LC
Ortolan bunting *(Emberiza hortulana)*	field	stable	LC	Serin *(Serinus serinus)*	farmyard	moderate decline	LC
Kestrel *(Falco tinnunculus)*	edge/bush	moderate decline	LC	Turtle dove *(Streptopelia turtur)*	edge/bush	moderate decline	LC
Crested lark *(Galerida cristata)*	field	moderate decline	LC	Spotless starling *(Sturnus unicolor)*	edge/bush	moderate increase	LC
Thekla lark *(Galerida theklae)*	field	moderate increase	LC	Starling *(Sturnus vulgaris)*	farmyard	moderate decline	LC
Barn swallow *(Hirundo rustica)*	farmyard	moderate decline	LC	Whitethroat *(Sylvia communis)*	edge/bush	moderate increase	LC
Red-backed shrike *(Lanius collurio)*	edge/bush	stable	LC	Hoopoe *(Upupa epops)*	edge/bush	uncertain	LC
Woodchat shrike *(Lanius senator)*	edge/bush	moderate decline	LC	Lapwing *(Vanellus vanellus)*	field	moderate decline	LC
Black-tailed godwit *(Limosa limosa)*	field	moderate decline	NT				

a) Habitat category according to[23]
b) Long-term population trends of common farmland birds in Europe according to EBCC (2008)
c) IUCN Red List Conservation Status: LC = least concern; NT = near threatenedf[24]

Table 4 also includes the European population trend and global conservation status of each of the 33 EBCC species. EBCC classifies the populations as in moderate decline for 18 of the species, in steep decline for 2 (tawny pipit, *Anthus campestris* and grey partridge, *Perdix perdix*), uncertain for 4, stable for 3, and as *moderately increasing* for 6 of the species.

With respect to worldwide protection, 32 out of the 33 EBCC species are considered of least conservation concern under the IUCN's global Red List Categories[24]. The one exception is the black-tailed godwit *(Limosa limosa)* which is listed as *near threatened*.

The IUCN red list categories are intended to represent the global conservation status of the species, whereas the EBCC population trends are limited to Europe. This may explain the difference in the European and global status of the birds. Also, many of the species are not confined to Europe and therefore have other factors outside of Europe influencing their populations.

> Birds are a useful indicator for monitoring changes in biodiversity on agricultural land. The European Bird Census Council's list of 33 farmland bird species can be used to monitor such changes.

5.2 Population trends of European farmland birds

Population trends of European farmland birds are highly diverse, and long-term trends can show considerable fluctuations over time. A comparison of the population data for the 33 EBCC farmland species shows an overall decline in some species *(Figure 12)*, others have stable or fluctuating populations *(Figure 13)*, and some are increasing *(Figure 14)*.

Population trends also often exhibit regional variation within individual species, where a species can be increasing in some countries but declining or stable in others *(Figure 15)*. Summarising the different species into one single trend for all farmland birds does not reflect the biotic reality.

Figure 12 A farmland bird species with a declining population according to EBCC

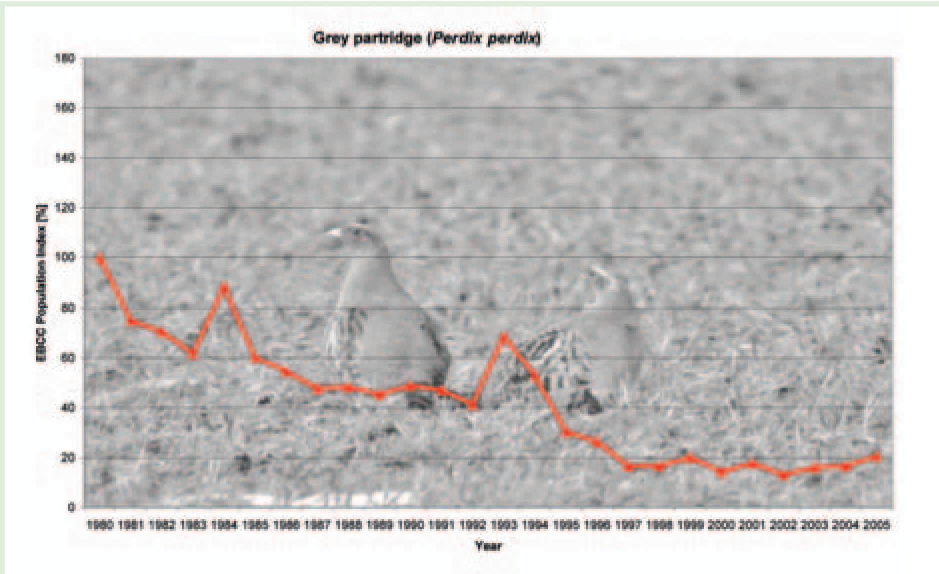


Figure 13 **A farmland species with a stable population according to EBCC**

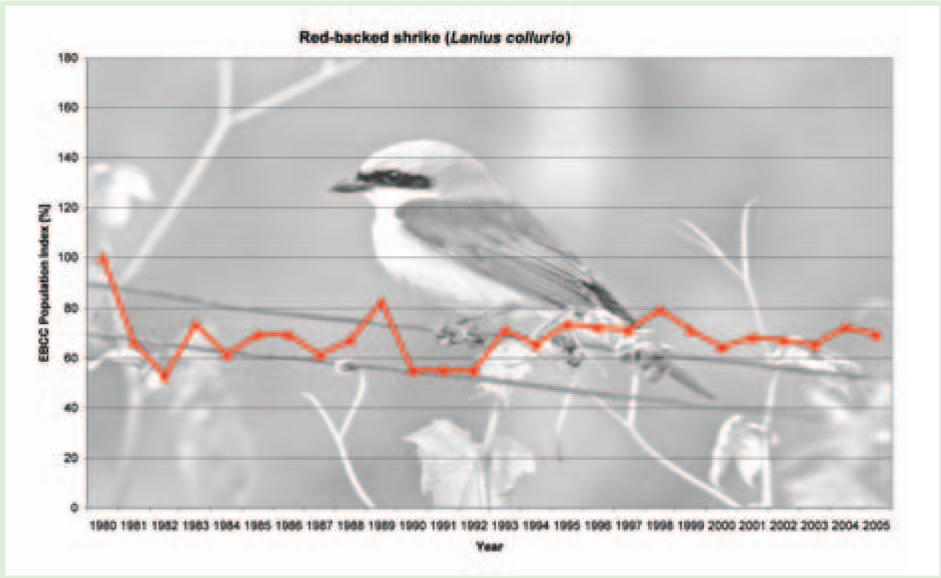


Figure 14 **A farmland species with a increasing population according to EBCC**

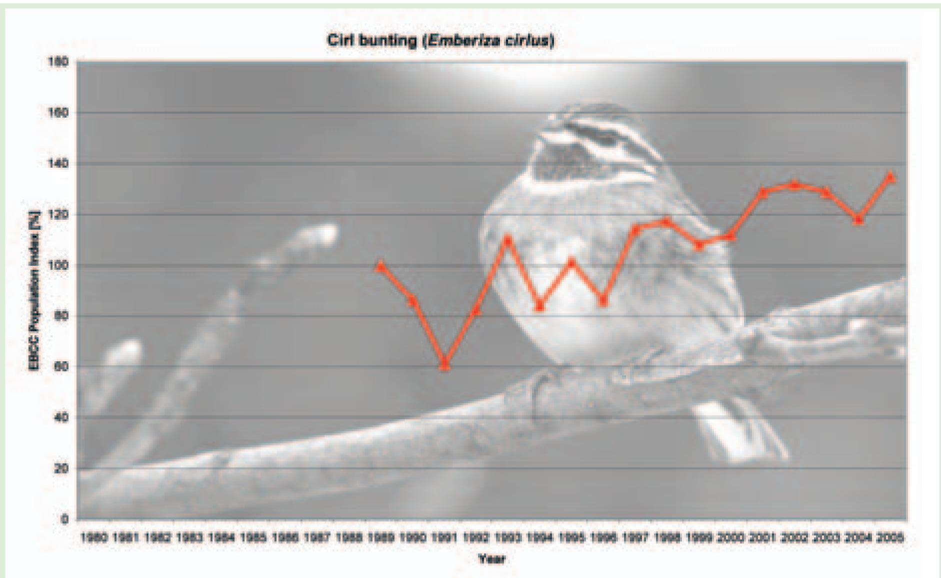
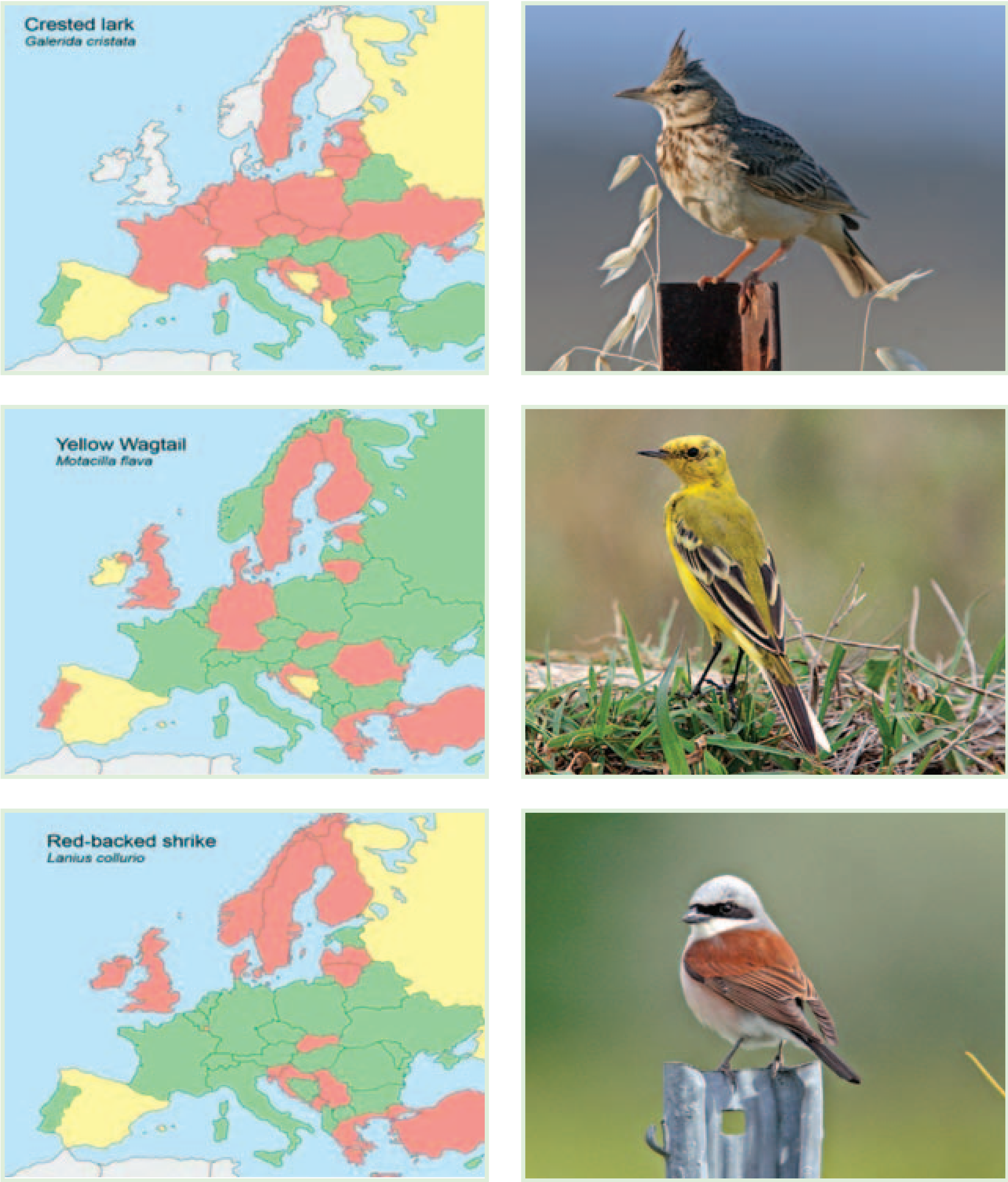


Figure 15 **Population trends of farmland birds may vary from country to country: crested lark (top), yellow wagtail and red-backed shrike (bottom)**



Adapted from[24]

Photos: Michael Riffel

Red: decline; **green:** stable/increasing; **yellow:** data deficient; **grey:** out of range/out of Europe

Plotting all the individual population trends of the 33 EBCC farmland bird species in Table 4 leads to the following graph:

Figure 16 Summary of species population indices for the 33 farmland bird species used in the farmland bird index of the EBCC[11]

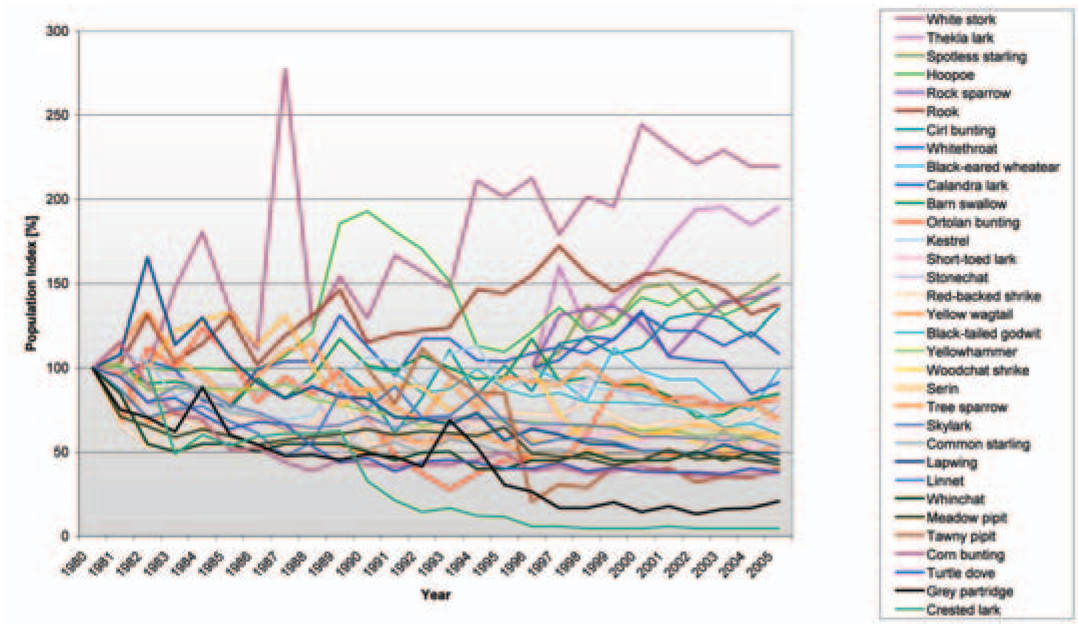


Figure 15 illustrates the how the populations of the 33 farmland bird species have changed between the years 1980 and 2005. It shows that the majority of species have declined in numbers since monitoring began. There are a variety of reasons for this trend, most of which will be discussed in detail in section 5.3, however the shape of the graph deserves some explanation at this stage as the change in the rate of decline or increase of the various species is rather revealing.

If one looks at the lines which fall under the initial population index of 100, i.e. those that have seen a population decline since monitoring began in 1980, it can be seen that the highest rate of decline occurred between 1980 and 1995. It is reasonable to suggest that this was, at least in part, the result of policies adopted by many European governments in the light of the technical and structural changes to farming at that time. Indeed for several decades it was government policy in many countries in Europe to pay farmers to effectively reduce biodiversity by draining wetlands and removing hedges to enlarge fields to take advantage of new technology. This goes some way to explaining the steep decline in many farmland bird species during that period. However, if one looks at the same lines from around 2000 the lines tend to flatten out. This indicates that any negative effects of agricultural practices on farmland bird populations are having much less of an impact than they did previously. The adoption of modern agriculture was more or less achieved everywhere by that time, and in addition, awareness of the biodiversity loss was being combatted with poilcy measures. The rate of decline since then is far less and there are signs of more stability in numbers, which is likely due to better practices and effective policy. This analysis has recently been backed up by the Commission where it was said, "...farmland birds declined rapidly in previous decades and are now starting to stabilize…"[22] This trend needs to be encouraged further.

---

[11] Note: EBCC monitoring commenced in 1980, where all species were assigned a population index of 100; all subsequent years of monitoring are therefore presented relative to their 1980 status.

Data shows that there is high diversity among the trends of farmland bird populations in Europe. Summarising all the species into one general trend, does not reflect the biotic reality. Whilst there has been significant decline in many species since the 1980's, the rate of decline has slowed down significantly over the past decade and there is far more stability in bird populations than was the case 25 years ago. In other cases, species have shown increasing populations.

5.3 Reasons for population changes

A number of reasons are given in the following to explain the dynamics in bird populations in European agricultural lands.

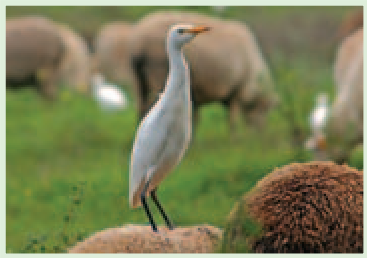
5.3.1 Decline of traditional farming practices

As mentioned in the previous section, adjustments to farming practices, resulting from several policies, led to a significant loss of biodiversity. Key changes in agricultural practices *(see Table 1)* have had major influences on the environment and its fauna and flora. Several traditional farming practices were extremely beneficial for certain bird species and contributed to population increases. Sheep farming, maintenance of traditional orchards, or coppicing are examples of farming practices which are both locally and broadly, declining. Following the reduction of habitats formed by these practices, it is no surprise that the inhabiting bird species show declining trends *(Figure 17)*. The cessation of certain agricultural practices such as these traditional methods has been described as 'as much of a threat to semi-natural ecosystems as intensification of production'[3].In eastern Europe in particular, major changes arose in farming practices, while those countries prepared for accession. The result was that the focus was shifted from traditional farming methods, and the diversity and hardiness of crops and animals, in favour of more intensive and specialised agriculture[3]. There were very significant technical and structural changes, brought about to take advantage of the mechanical, chemical and biological revolutions in farming techniques, which happened all over the developed world as these capital inputs were substituted for labour and land. The impact of the use of these techniques in collectivised farming in the new Member States was dramatic as efficiency and maximum productivity became the key.

Figure 17 Examples of farming practices which are declining with corresponding declines in certain bird species

Sheep farming

Traditional orchards



Cattle egret
(Bubulcus ibis)

Little owl
(Athene noctua)

Photos: Michael Riffel, Carsten Wagner

Several farmland bird species benefited from historical farming practices. The decline of these practices is often followed by declines in the bird species inhabiting these areas.

5.3.2 Landscape structures

Agricultural practices strongly influence the structure of the landscape and also indirectly the populations living within them. Often, nature conservation programs are established to protect one defined species. However, there can be conflict between the needs of different bird species for different landscape structures within one territory. For example, many field species which are regarded as declining in European agricultural landscapes (e.g. lapwing, grey partridge, quail, tawny pipit and ortolan bunting) require open landscapes with few trees, hedges and tree alleys. An increase of these structural elements leads to a decreased abundance of these species.[26] For example, northern lapwings select open habitats, distant from suitable predator perches and linear features[27], such as field boundaries, trees and hedges. Nest survival has been shown to increase when nests are placed further away from predator perches and/or boundary features.
Some species in particular wintering populations clearly benefitted from the lack of structures in highly intensified arable landscapes. The Eurasian golden plover, various species of wintering geese and finches do very well in intensively farmed arable land[28].

However, the loss of ecological heterogeneity as a consequence of agricultural intensification and landscape homogenisation has had negative impacts on other bird species[29]. For example, the abundance of hedge, forest and farmyard species (e.g. whinchat, wheatear, tree sparrow, swallow) is positively correlated with the amount of field variety, combinations of crop and grasslands, number of farmsteads and other structural elements such as field margins, fences, hedges, ditches[26].

Therefore, clear targets must be defined when landscape structures are deliberately managed to maintain or enhance biodiversity. The key to success here is close and trustful collaboration with farmers and the integration of their needs in the target-setting process.

Landscape structures are a key influencing factor for bird biodiversity and may be the subject of nature conservation and management practices. Clear targets must be defined when landscape structures are deliberately managed to maintain or enhance biodiversity, as their development can have a highly variable impact on different species.

5.3.3 Climate Change

Climate change is expected to have a profound impact on many species and ecosystems, including birds. In Europe, average temperatures are expected to rise by between 2°C and 6.3°C above 1990 temperatures by the year 2100[9]. Different bird species will respond differently to these changes. Inevitably, some will benefit from a modified climate, others will be less able to cope with these challenges. Changes in climatic conditions are likely to affect or influence[30] :

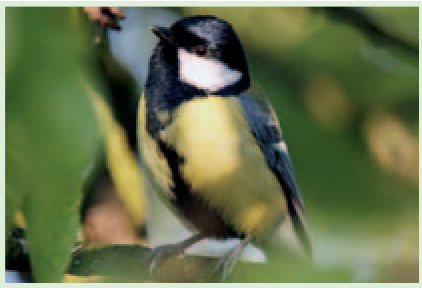
- Metabolic rates
- Foraging and habitat conditions
- Breeding performance (egg size, breeding success) and timing
- Migration

}

- Population sizes
- Species distributions

Changes in these parameters may be reflected by increasing or decreasing populations sizes and/or expansion or retraction in geographical distribution. Some bird species appear to already be exhibiting population changes *(Figure 18)*.

Figure 18 Responses of some birds to climate changes



In response to climate warming the great tit (Parus major) shows advanced egg-laying and hatching of juveniles[31].

As the climate is becoming less suitable, the current distribution of black-tailed godwit (Limosa limosa) is expected to shrink in the UK [32].

The bee-eater (Merops apiaster).
The northward expansion of this species' breeding range has been facilitated by climate change[33] .

Photos: Michael Riffel

Climate change is expected to have a profound effect on bird populations in Europe by affecting their habitat, diet, breeding success and migration.

5.3.4 Predation

Predation is another factor which contributes to changes in species diversity. Increases in predator numbers and the associated rise in nest predation can have a major impact on bird populations, particularly those of large to medium-sized ground-nesting species[34] *(Figure 19)*. Losses caused by predators can outweigh increases achieved from conservation management programmes[35]. Habitat quality and the size of the respective prey and predator populations have a major influence on predation frequency[36]. In particular, generalist predators such as the fox *(Figure 20)*, may change their diet when the availability of alternative prey is reduced[34] (which may occur when mouse populations decline).

Figure 19 Ground-nesting farmland birds may be targets of predators

Photos: Michael Riffel, Christian Wolf, Marcel Münderle

Among ground-nesting bird species particularly affected by predation are (clockwise from top left) the calandra lark (*Melanocorypha calandra)*, zitting cisticola (*Cisticola juncidis*), northern lapwing *(Vanellus vanellus)*, little bustard *(Tetrax tetrax)*, yellow wagtail *(Motacilla flava)* and grey partridge *(Perdix perdix)*.

Figure 20 Some predators

The red fox (*Vulpes vulpe*s, left) is the most important mammalian predator of ground-nesting birds and has a major impact on their population development. Carrion crow (*Corvus corone*) predation locally impacts grey partridge and lapwing populations.

Photos: Michael Riffel

An increase in the number of predators of birds in European agricultural land has been reported by a number of authors[33, 36, 37] and is thought to result from::

- Human control of top-level predators, which increases population levels of medium-sized predators and overall predation rates.
- Changes in hunting policies.
- Conservation measures designed to protect certain predator species.
- Changes in habitat quality which influences the ability of a prey species to cope with increased predation rates (e.g. increased nest densities, unfavourable nest-site habitat, shortened breeding seasons).

Predation can have a large negative impact on ground-nesting farmland birds in Europe. An increase in the number of predators has been reported in many European countries.

5.3.5 Introduced species

Introduced species also form part of biodiversity. However, they are often regarded as "invaders", or agricultural pests and according to various authors[38, 39] can influence the original native flora and fauna. Introduced species *(e.g. those illustrated in Figure 21)* may affect native populations by:

- Increasing competition for resources (food, nutrients, breeding habitat).
- Predation.
- Hybridisation.
- Habitat destruction and modification.
- Introduction of parasites and pathogens.

Figure 21 Bird species introduced on to agricultural land by humans

Bar-headed goose
(Anser indicus)

Red-legged partridge
(Alectoris rufa)

Common waxbill
(Estrilda astrild)

Photos: Michael Riffel and Alta Oosthuizen 2010 Used under license from Shutterstock.com

In addition to those species introduced by humans, other species have recently expanded their ranges naturally, without human interference *(e.g. the Eurasian collared dove, Figure 22)*. Many of today's farmland species are yesterday's newcomers because they expanded their ranges into areas which were previously forested and have now been cleared for agriculture.

Figure 22 The Eurasian collared dove: a successful immigrant (adapted from[41])

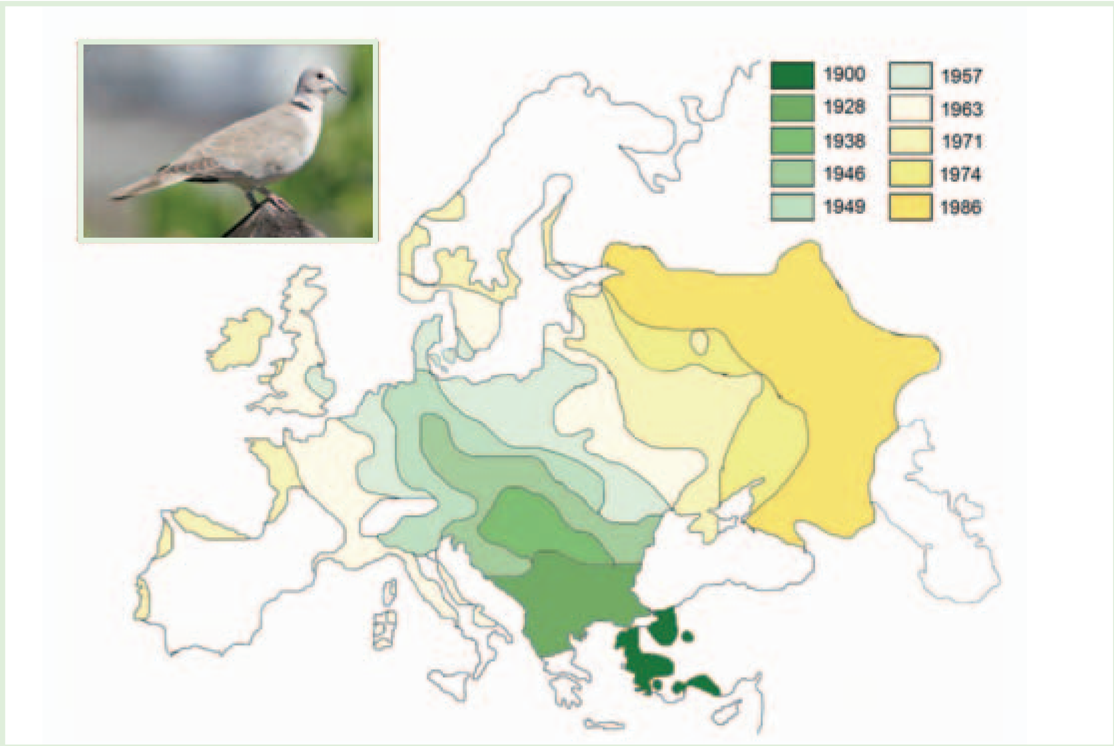


Photo: Michael Riffel

Introduced or immigrated species are also part of biodiversity. However, they can be viewed critically as some can negatively affect native species.

5.3.6 Other factors influencing bird populations

This short compilation of factors which may influence farmland bird populations in Europe, is not exhaustive. Other important factors include continuing urbanization and farmland abandonment, which are both clearly linked to habitat availability and changing land use practices. In many European countries, the open landscape is diminishing as it makes way for expanding villages, towns and cities in the light of the rapidly increasing human population. The European urban area has already risen by 20% since 1988[42]. This clearly has a significant impact on bird numbers as their natural habitat is lost.

Figure 23

Habitat destruction by expansion of urban areas is one of the main threats for European bird populations.

Photo: Gualberto Becerra 2010 Used under license from Shutterstock.com

Although it might not always be obvious, the marginalization, and under-utilisation of land as well as farmland abandonment have also resulted in significant biodiversity loss and no doubt diminishing bird populations. The decline of farmed areas in eastern Europe is the main issue of concern with respect to impacts on biodiversity[3]. Furthermore, abandonment of farmland, particularly where farming conditions are arduous *(e.g. medium and high altitude pastures)*, leads to impoverished ecosystems that rely on the continuation of such activities. Although alternative management of the land in such cases is the best solution as regards ensuring rich biodiversity, farmers generally remain the most logical managers of the land. The value of managed or farmed land with respect to protection of birds, and thus more broadly biodiversity protection, should not be underestimated.

6 CASE STUDIES

6.1 Working together

Key elements of agriculture and biodiversity protection, are that both require actively managed land, and resources such as funding, manpower and expertise.

It is realistic to assume that, globally, EU-wide, nationally and regionally, pressure on these requirements will become greater under future agricultural conditions *(Section 2)*. Clearly modern agriculture and biodiversity are not mutually exclusive. Biodiversity is essential for sustainable modern agriculture for reasons discussed in Section 4. Without them modern agricultural practices would quickly cease to be productive. Conversely modern farming practices play a significant role in the protection and promotion of biodiversity, either by introducing species, maintaining optimal conditions for species already inhabiting the area and increasing yield on existing land therefore leaving remaining land aside for conservation purposes.

Any new land management policies should be "synergistic" in that they strike an effective balance between ensuring continuing successful agricultural production and biodiversity protection. One should not come at the cost of the other, as both are essential.

6.2 Agriculture can be compatible with bird conservation

This chapter provides several examples of how defined habitat management practices can successfully increase the populations of certain bird species. Case studies are presented for the: skylark *(Alauda arvensis)*, grey partridge *(Perdix perdix)*, lapwing *(Vanellus vanellus)*, corn bunting *(Miliaria calandra)*, corncrake *(Crex crex)* and geese and swan species.

6.3 The Skylark

Skylark populations have declined by around 50% in Europe and 90% in the UK since 1962 *(Figure 16)*. The reported main reasons in the UK are changes to farming practice and the switch by cereal farmers from traditional spring-sown wheat to more economically viable 'winter wheat' varieties which are sown in the autumn. This has caused changes to the skylark's habitat and resulted in the selection of unfavourable nesting sites, increased predation rates and losses due to farming machinery[36].

Figure 24 The Skylark

The skylark (Alauda arvensis), a ground-nesting farmland species whose population in Europe has steadily declined over the last 25-35 years with no sign of stabilisation.

Photo: Christian Dietzen

Following extensive research, a solution to the skylark breeding habitat problem was proposed and recently field-tested in the UK. The recommended solution was to create 'skylark plots' within crop fields by turning off the seeding drill for several seconds to create a bare stretch within the crop field. Each plot eventually consists of a five to ten metre long area of the crop field colonised by non-crop vegetation which provides ideal breeding and feeding habitat for skylarks. This measure subsequently produced a 200% increase in skylark numbers at the test site over a six year period[43]. Once skylark plots are formed the application of fertilisers and crop protection products can proceed as scheduled without adversely affecting the breeding success of the birds. This kind of programme is today applied more widely in the UK and other Member States such as The Netherlands, Germany and Denmark. It requires clear guidance and close collaboration with farmers.

6.4 The Grey Partridge

Grey partridge populations in Europe appear to have plummeted to less than 20% of their 1980 values *(Figures 12 and 16)*. Grey partridges are a ground-nesting species with a preference for cereal field margins where their young forage for insects and other invertebrates which is a vital source of protein in early life.

Figure 25 The Grey Partridge

The grey partridge (Perdix perdix), a ground-nesting farmland species whose population has declined by 80% in Europe over the 25 year period between 1980 and 2005 (right).

Photo: Marcel Münderle

The underlying reasons for the decline in grey partridge numbers, centre on what has been called '…the deterioration of the bird's agricultural habitat' [37]. This has involved the widespread removal of a significant proportion of suitable nesting habitat in the form of insect-rich brood-rearing areas such as hedgerows and grass banks from the agricultural landscape. In turn, this has led to a marked reduction in chick survival rates which have been shown to be the primary factor for the overall decline in numbers[44 37].
The UK grey partridge restoration project includes the formation and management of areas such set-aside strips managed as adjacent bands of cereal mixtures and tussocky grass distributed around the farm for nesting[37]. With adequate habitat available, chick survival rate can increase significantly (+54%) and in cases where management includes predation control, population densities have increased by as much as 176% in two years [37, .45]

In northern Germany a grey partridge recovery project was been set up in 2004. In 2007 a total of 500 ha partridge-suitable field margins have been created by supplying farmers with a special seed mixture. The farmers are also compensated for partridge adapted management of field margins. As a result the number of calling male partridge increased by a factor of ten within three years[46].

6.5 The Lapwing

Lapwing populations in Europe have decreased more or less continuously by about 50% since 1980[24].

Figure 26 The lapwing

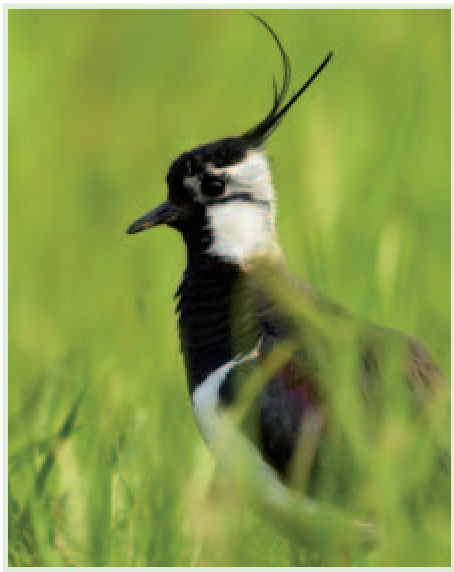


Photo: David Dohnal 2010 Used under license from Shutterstock.com

The lapwing *(Vanellus vanellus)* numbers have declined dramatically since 1983.

Lapwings have been shown to express a strong selection for spring-tilled fields adjacent to grasslands with an equally strong avoidance of dense winter-sown crops[21]. In the UK with the co-operation of landowners and farmers, agricultural land was managed in a way to include the incorporation of spring crops (cereals and/or root crops) in large open fields with few predator perches and the cessation of agricultural operations between late March and the end of May. These measures have been shown to promote lapwing breeding success and led to an increase (+19%) in lapwing numbers from 141 pairs in 2000 to 168 pairs in 2003[21].

In Switzerland cooperation between landowners and farmers with conservationists ensured a stabilization of local lapwing populations. Measurements included protection of clutches by fencing and omission of an area of 2x3 m around nest sites from agricultural operations such as tillage and sowing[47]. In Germany a number of so-called nature conservation projects by agreement have been implemented. Cooperating farmers receive compensation payments for their willingness to manage their fields in order to minimize detrimental effects for meadow birds such as lapwings and godwits. As a result some projects achieved to maintain and even increase the target populations[48].

6.6 The Corncrake

The corncrake *(Crex crex)* has a wide range throughout Europe. It winters in south-eastern Africa before returning to Europe to breed, where it prefers agricultural grasslands characterized by tall vegetation (at least 20 cm in height) which provide dense cover[49]. Population declines of the corncrake have been reported as early as the mid 19th century but these accelerated after 1950 and by the 1980s the species hovered at the verge of extinction in a number of western European countries[49].

Figure 27 A calling corncrake

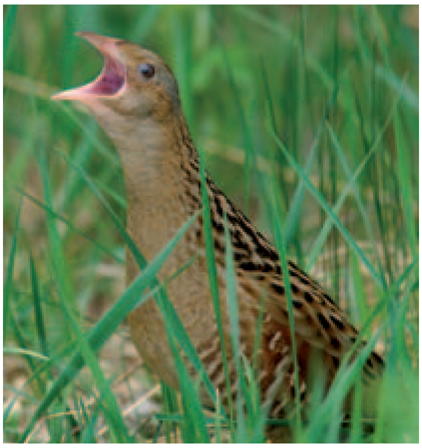
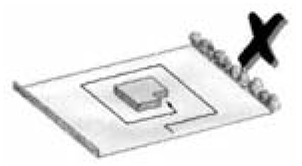


Photo Ainars Aunins 2010 Used under license from Shutterstock.com

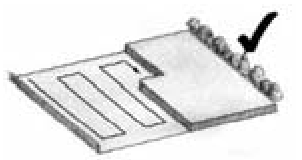
Even if corncrakes have been globally downlisted as 'near threatened', the conservation status is still unfavourable, since many populations depend on agriculture and large parts of the core breeding areas are currently being abandoned by agriculture[50].

The corncrake breeds late in the season and studies in Poland, Germany, UK, France and Ireland[49] have revealed that it is particularly susceptible to early mowing. In Ireland mowing generally takes place from mid-June onwards and as such can threaten nests and broods. As corncrakes are reluctant to run out across open parts of the field that have been mowed they remain trapped in the centre of the field as mowing machines work from the outside of the field inwards[51].
A corncrake conservation programme has been established in Ireland where field workers in each of the core corncrake areas count calling males and advise farmers on "corncrake friendly" farming methods. Farmers with corncrakes in their meadows are eligible for entry to the Corncrake Grant Scheme. Grants are payable to those farmers who delay mowing of hay or silage until the 1st August, by which time most corncrakes should have hatched two broods. There is a further grant for mowing from the centre of the field outward, which gives corncrakes a chance to escape towards the edges to safety *(Figure 28)*. It is estimated that the productivity of corncrakes would be increased by about 20% by switching to corncrake friendly mowing if the average mowing date is in early July and by 10% if it is in August[51].

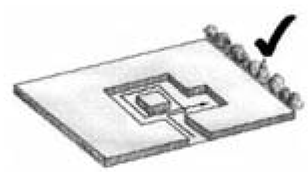
Figure 28 Corncrake 'friendly' mowing methods (adapted from[51]).



This method of cutting from the outside to the centre of the field, leaves nowhere for corncrakes and their young to hide.



Cutting the field in strips from side to side (left) or cutting from the gate towards the centre and out towards the edge (below) allows corncrakes to escape from the meadow to the safety of field margins. Farmers are encouraged to use and compensated for employing these methods.



6.7 The whinchat

The whinchat *(Saxicola rubetra)* is a small insectivorous passerine bird that inhabits agricultural landscapes throughout Europe. More than 75% of its global range is found in Europe[53]. Whinchats predominantly inhabit meadows, pastures, heathland, moorland and fallows characterized by perches such as shrubs or perennials of 0.6 to 1.3 m height. Habitats having between 50 and 100 perches per 100 m^2 are preferred[52].

Figure 29 The whinchat

Photo Michael Riffel

While declines have been reported throughout Central and Western Europe, increasing populations have been seen in parts of Eastern Europe such as Poland and Czech Republic[53].

Major threats for whinchats include early haymaking and lack of arthropods in meadows. Whinchats are sensible to mowing with reproductive success being strongly correlated with late haymaking. In the last decades a marked change in hay meadow management has been detrimental for this species. Hay meadows are mown more early and more often due to fertilizers and silage. Nowadays the first cut often coincides with and destroys the first brood of whinchats[54].

Intensive grassland management reduces the availability of arthropods as suitable whinchat nestling diet and thus leading to more extensive foraging distances for the feeding parents[55] . Conservation actions should therefore not only concentrate on the reduction of nest losses by postponing mowing, but should also promote grassland farming that is less detrimental to invertebrates.

A population increase of up to 70% has been reported from an Austrian whinchat conservation project after local farmers cooperated and have been compensated for postponing the first mowing beyond June 20th and for implementing unmown grassy margins of 2.5 m width. Similar results were obtained from nearby Bavaria where whinchat populations increased after the onset of conservation measures like unmown grassy margins, removal of copses and postponement of haymaking. This was possibly through the cooperation and compensation of farmers[56].

6.8 The Montagu´s harrier

Montagu´s harrier *(Circus pygargus)* is a ground-nesting raptor that mainly breeds in western European cereal crops. This dependence renders Montagu´s harriers particularly vulnerable to all man-made activities occurring in this habitat. Besides decreases in potential prey availability following modifications in agricultural practices, this ground-nesting species particularly suffers from losses of nestlings due to cereal harvesting.

Figure 30 Montagu´s harrier

Photo Mitalpatel 2010 Used under license from Shutterstock.com

Bird protection non-governmental organizations participate in Montagu´s harrier protection, in collaboration with concerned landowners and farmers. Once a nest is spotted in a field, it can be safeguarded by creating a protected space which will not be harvested and by fencing it with an electrical fence. Compensations are paid for landowners and farmers for their cooperation throughout the range of the species.

In the German state of Bavaria which harbours the bulk of German Montagu´s harriers, protection of nesting sites is a big conservation success story. The number of breeding pairs increased from two pairs in 1994 to 131 pairs in 2008 in Mainfranken one particular region of Bavaria[57]. In 1999 the Montagu´s harrier conservation project was implemented by the Bavarian regional authorities. Nests are searched and protected during the breeding season. Farmers and landowners, who leave the nests and an area of 50x50 m around the nests intact, are compensated for their financial loss. Similar and successful projects based on the cooperation and compensation of cereal farmers have been implemented in other parts of Germany[58,59] and on a wider scope in a number of European countries such as Spain, Portugal, The Netherlands, Poland, France, Denmark and Austria [60].

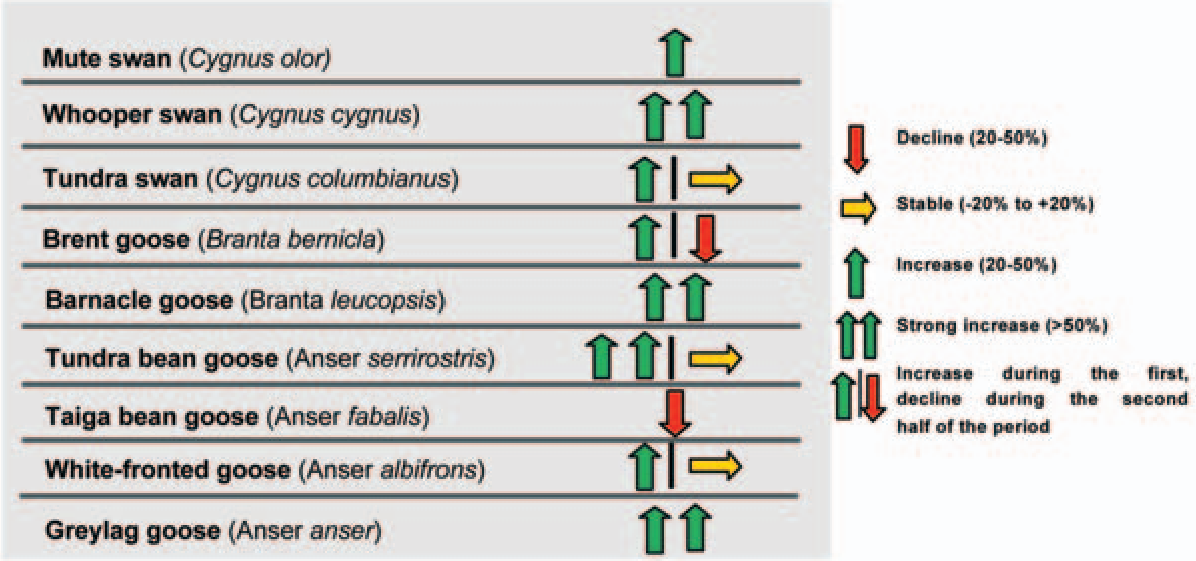
6.9 Wintering geese and swans

Open agricultural fields have become important feeding habitats for wintering geese and swans in several European countries including Germany, the UK, The Netherlands, Denmark, Norway and Belgium since the last decades. Here these species feed on the readily available infield crops, which are usually cereals but also certain vegetables. This may cause considerable damage to the crop and can impact on harvests. In a number of countries such as The Netherlands, Germany and Norway goose management systems are in place to compensate farmers for this damage[61]. Most goose species exploiting these new and nutrient rich feeding opportunities have shown expansions in range and population size in the last 40 to 50 years[62, 63, 64, 65] (*Figure 32*).

Figure 31 Greylag geese on a winter cereal field

Photo: Michael Riffel

Figure 32 **Development of wintering geese and swan numbers between 1980 and 2005 in parts of Germany (from[66]).**



6.10 Conservation of non-avian farmland organisms

In addition to the conservation schemes for farmland bird species discussed above, a number of other schemes have been initiated in Europe for the conservation of non avian farmland species. For example, the Sustainable Arable Farming For an Improved Environment (SAFFIE) project was established in 2002 to investigate a range of options for the conservation of farmland biodiversity.

A key element of the SAFFIE project included assessing techniques for the management of crops and field margins to maximise biodiversity. Results from the project showed that the addition of wildflowers to grassed margins, the selective use of herbicides and margin management practices such as sward scarification† can lead to significant increases in plant and invertebrate biodiversity[50].

Figure 33 **Botanically rich field margins are key elements to maximise biodiversity**

Photo: Michael Riffel

Table 5 Effects of sward scarification on margin management (adapted from[67])

- Increased bare ground cover relative to other treatments
- Helps maintain wildflower species sown in the sward
- Instigates a convergence of plant community composition between seed different mixes
- Tends to promote the resource abundance of unsown components

Sowing a diverse seed mixture of wildflowers onto arable field margins was found to be the most effective way of creating foraging habitat for beneficial invertebrates such as bees and butterflies. The abundance and diversity of soil feeding invertebrates significantly increased with management practices such as scarification. These findings show that the appropriate management of field margins can lead to overall increases in biodiversity. The SAFFIE project also highlights the requirement for appropriate financial support for biodiversity conservation in agricultural lands.

A number of projects have been initiated in Europe for the conservation of farmland species. SAFFIE is an example of one such project. The results of this and other projects show that appropriate management schemes can be implemented which maintain and increase farmland biodiversity.

† *Sward scarification is the loosening of the top soil and overlying mat of grasses and roots.*

6.11 What can be learned from the case studies?

The case studies discussed in Sections 6.3– 6.10 illustrate that agricultural practices clearly can be part of conservation strategies. A multitude of measures to promote biodiversity or to protect defined species in agricultural lands have been successfully implemented while allowing continued agricultural production.

Close collaboration between farmers and nature conservation staff is essential to the success of a project. Any programme should ensure that:

- the measures taken are sustainable, and
- there is a balanced benefit for both the farmer and the species/ecosystems being protected.

To ensure these aims are achieved there must be mutual understanding between the parties involved before a project starts. Based on that, a programme can be defined which should address:

- Consistency of protection goals; this may be not obvious, as illustrated in the example of "hedges" (see Section 5.3.2).
- Economic viability for farmers and local communities; adequate production must be considered as a key target for agriculture.
- Availability of resources; this means not only funding, but also expertise or political support.
- Continuity in availability of resources; resources, as mentioned above, must be provided during the entire project duration (and the project duration must be adjusted to the protection goals).

In this way a careful balance can be struck which maintains or protects biodiversity while allowing for continued agricultural development and sufficient production.

> The case studies discussed in this section illustrate that farming practices can be part of nature conservation strategies. A number of targeted measures to promote biodiversity or to protect defined species have been successfully implemented, while allowing continued agricultural production. Close collaboration between farmers and nature conservation organizations is vital to any project. Consistency of protection goals, economic viability of farmers and availability and continuity of resources should all be assured.

7 CONCLUDING REMARKS

This document goes some way to depicting the important link between farming and biodiversity in agricultural landscapes. There are mutual and complex interactions between agriculture and biodiversity: agriculture is an element of biodiversity, it needs biodiversity and it influences biodiversity.

Today there is far wider understanding of the importance of biodiversity both economically and socially as well as culturally. The ecosystems providing the many benefits we all rely on need protection. There is a desire among farmers and land managers to play their important role in ensuring that societies' demand for affordable, safe and abundant food does not come at the cost of environmental degradation.

A number of case studies explain how straight forward cost-effective targeted measures for certain bird species can have a major impact on their populations and thus biodiversity as a whole. In this context, closer collaboration between nature conservation staff and farmers and land managers should certainly be encouraged further.

Whilst it has not been discussed in detail here, there is clearly room for further extensive research and development, particularly in the context of upcoming influences on agriculture in Europe.

The mounting demands placed on farmers today, resulting from the effects of climate change, population increase, rising affluence and competition for land, to name just a few must be taken into consideration when introducing biodiversity protection concepts. By doing so and by accepting the fact modern agricultural practices are a vital ingredient for providing all that society expects from farmers, sustainable and manageable concepts for biodiversity protection are achievable.

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