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Agro-biodiversity evaluation in Sicilian farmlands entered into agri-environment scheme agreements

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Abstract – To test if the application of Rural Development Regulation 1257/1999 played a possible role in maintaining or increasing biodiversity, monitoring of the avifauna has been carried out in 2004-2005. On the whole, 836 point counts were carried out, 418 in spring and 418 in winter, evenly shared between 16 farmlands entered into F2 and F4 agri-environmental measures, and an equal number of "not enhanced" farmlands, which represented test-farms and control-farms, respectively. Between bird frequencies within test-farms and control-farms statistical differences have been dected; farms entered into agri-environmental measures showed, on average, higher values of species, frequency of occurrence and "priority" species than controls, stressing a general issue: within enhanced farmlands bird communities are richer in species and priority species number. A remarkable species turnover between spring and winter communities has been observed. This may be due to farmland management which eventually influenced in some way the presence of more ecologically exigent species, through the seasons.

Riassunto – Nel 2004-2005 è stato effettuato un monitoraggio delle comunità di uccelli per controllare se l'applicazione delle misure agro-ambientali del Piano di Sviluppo Rurale ha effettivamente giocato qualche ruolo positivo nel mantenere o incrementare la biodiversità. Sono stati effettuati 418 punti d'ascolto in primavera ed altrettanti in inverno, per un totale complessivo di 836, equamente distribuiti all'interno di 16 aziende sottoposte a misure agro-ambientali F2 ed F4 ed in altrettante che non hanno aderito a misure agro-ambientali, localizzate a 2-7 km dalle precedenti. L'analisi statistica ha consentito di rilevare differenze significative tra i risultati ottenuti all'interno delle 16 aziende e quelli ottenuti al di fuori di esse; in media, all'interno delle aziende sottoposte a misure agro-ambientali sono stati riscontrati valori maggiori rispetto alle altre aziende, sia del numero di specie, sia della loro frequenza, sia del numero di specie "prioritarie". Un ricambio consistente è stato osservato tra le comunità riproduttive e quelle svernanti. La maggiore ricchezza delle comunità di uccelli nelle aziende sottoposte a misure agro-ambientali può dipendere dalle forme di gestione delle suddette aziende, che possono avere influenzato, in qualche modo, la presenza di specie ecologicamente più esigenti, sia durante il periodo riproduttivo sia durante l'inverno.

INTRODUCTION

Biodiversity is one of the three priority levels for the European Union, together with water and climate change; according to the communication on strategic guidelines for the 2007-2013 period (COM 2005, 304 final), the Rural Development Regulation (RDR) must contribute positively to achieve these priority aims. It is, indeed, one of the instruments that EU provides to Member States in order to promote, in the agricultural sector, a better equilibrium between advantages from agricultural activities, mainly from extensive systems, and biodiversity conservation. Agri-environment schemes were introduced into Community law in the 1980s; although designed primarily as a production control measure, environmental benefits were widely expected from set-aside. Over the last fifteen years consideration of biodiversity in European agricultural policies has been reflected in a review of the Common Agricultural Policy (CAP) and modernisation of the farming subsidies scheme. In Europe since 1992 the MacSharry reforms made agri-environment schemes available for all Member States; the European Regulation 207/92 requires Member States to implement the agri-environment schemes, as the multifunctional concept of agriculture, the principle of decoupling whereby the aid allocated is no longer proportionate to the amount produced, and so on. This was further reinforced under Agenda 2000, when agri-environmental programmes became obligatory. Since the financial year 2000/2001, the CAP has forced farmers with a total annual yield of cereals of more than 92 t to set aside

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between 10 and 33% of their arable land. A further novelty was the article 69 of EU 1782/2003 Regulation, which provides the possibility to establish a national reserve up to 10% of direct payments to support agricultural activities and production typologies promoting biodiversity conservation. The agreement reached by Ministers for Agriculture in 2003 established that all EU agricultural subsidies should be conditional upon compliance with environmental standards. EU Member States confirmed in 2005 these developments with the new Community Regulation on rural development.

With the exception of primary steppes in eastern Europe, Palearctic open habitats are the result of the expansion of agriculture, started between 7,500 and 4,500 years ago, and consequently of the intense human impact upon the environment, deeply modified by fire, grazing and tree-cutting (Goriup 1988, Blondel and Aronson 1999). The CAP of the EU promotes the maintenance of cereal steppes (= farmed landscapes) through agri-environmental regulation based on the compensation of farmers for maintaining agricultural practices allowing the conservation of threatened species. Today these landscapes support many priority bird species, of which nearly 70% have unfavourable conservation status in Europe because of their declining populations (BirdLife International 2004). Although farmland birds may respond in different ways, depending on their specific habitat and resource requirements, intensification of agricultural systems and land abandonment have been identified as a major factor in the decline of many species (Tucker and Heath 1994, BirdLife International 2004, Cunningham *et al.* 2004). According to Buckwell and Armstrong-Brown (2004), land managers provide an increased output of non-market goods, which society requires, namely biodiversity, landscape, historic environment, natural resources and vibrant rural communities. Biodiversity is involved in many biological processes utilised by agriculture and allows farmers to produce food and other products; conversely, agricultural activity in certain cases enriches biodiversity, creates and maintains special ecosystems and habitats, such as the mosaic of cultivated fields and field boundaries spaced by hedges and ditches, providing refuge and food-sources for certain animal species. Sustainable agricultural policies should control intensification through regulatory measures and removing economic incentives to intensification. Agricultural intensification has reduced environmental heterogeneity at different scales, producing negative effects on biodiversity, with the loss of animal food resources and the worsening of habitat quality. Changes in farming practices produced a loss of summer and winter foods and nesting sites, increasing the limiting factors for farmland birds. For these reasons, many authors consider that large part of the responsibility in maintaining the biodiversity lays in the farmer's hands.

Nowadays, uncultivated areas may represent an important resource for birds and other animals, which live at the edges of cultivated areas, partially exploiting their resources (Fuller *et al*. 2004). According to Sutherland (2004), the future of farmland birds depends on the success of agri-environment schemes and on the changes in agricultural practices resulting from the development of new technologies. The interest of research on this topic is very high, entire books and conferences have been dedicated to farmland birds, mainly in central Europe (e.g.: O'Connor and Shrubb 1986, Goriup 1988, Goriup *et al.* 1991, Pain *et al*. 1997, Aebischer *et al*. 2000, Vickery *et al*. 2004b, Bota *et al*. 2005). Even if over 60% of the European Parties have indicated that Agriculture is a priority sector to address in ensuring biodiversity conservation and sustainable use (van Krabben and Drucker 2005), it has scarcely been shown that such mechanisms really help to conserve biological and landscape diversity (Bonnin *et al*. 2007). Keijn and Sutherland (2003) have listed 62 studies across Europe (from five EU countries plus Switzerland, most in the UK and the Netherlands) that examined effectiveness of agri-environment schemes for biodiversity, many of which were scientifically weak (e.g.: only 58% used controls); nevertheless, the experience of agri-environment schemes shows that they have patchy success (Sutherland 2004), even though their importance in dealing with conservation problems has been demonstrated in some cases (Wilson *et al.* 1997, Henderson and Evans 2000, Peach *et al*. 2001, Baines *et al*. 2002, Wrbka *et al*. 2008). Overall, agricultural policy and agri-environmental measures have a critical relevance in the maintenance of habitats able to host good densities of steppe-birds (Sanderson *et al*. 2005).

We report here the results of the bird monitoring, that is part of a survey carried out with the aim of evaluating the impacts of agri-environment schemes (AES) in relation to the objective of biodiversity conservation, using birds as indicators. It was one of the activities of the intermediate evaluation of the RDR 1257/1999 for the years 2000-2006 in the Sicily Region (Italy), carried out by Agriconsulting (Rome) on behalf of Assessorato Agricoltura e Foreste Regione Siciliana. Birds, indeed, are widely considered as good biological indicators (Gregory *et al.* 2004): they are widespread, at the apex (or nearly) of food webs, well known, popular and sensitive to environmental changes, reflecting changes in the status of other animal groups and certain botanical species populations, particularly in the agri-ecosystems (Sauberer *et al*. 2004).

Table 1. Types of agri-environment scheme agreements and farm location (number of point counts and provinces in parentheses), where bird censuses were carried out in spring and winter to evaluate biodiversity conservation. Total number of farms: 16 – *Tipologie di misure agro-ambientali e localizzazione delle aziende agricole (N di stazioni di ascolto per azienda tra parentesi) dove sono stati svolti i censimenti primaverili e invernali per valutare la biodiversità.*

F2a:	conversion and maintenance in zootechnical farms	5 farms: Castronuovo di Sicilia (20), Caccamo (5) (Palermo), Agira (5), Sperlinga (20) (Enna), Noto (10) (Siracusa)
F2b:	conversion of sowable ground into grazing to protect hill slopes from erosion	2 farms: Castronuovo di Sicilia (20) (Palermo), Tortorici (20) (Messina)
F2c:	production of sowable ground compatible with the environment and the landscape	2 farms: Prizzi (6) (Palermo), Mazzarino (10) (Caltanissetta)
F2d:	grazing with slope higher than 25%	4 farms: Polizzi (15), Caltavuturo (15) (Palermo), Leonforte (10) (Enna), Sortino (10) (Siracusa)
F4b:	planting of hedges and mixed mediterranean maquis and clearing within grazing and sowable ground	3 farms: Enna (8), Pietraperzia (15) (Enna), Caltanissetta (20)

STUDY AREAS

Table 1 explains the meaning of different agri-environment applied schemes in each farmland, Figure 1 shows farmlands' location. The survey was performed on areas characterized by sowable ground and grazing under set aside, thanks to RDR 1257/1999, previously entered into AES under the Regulation 2078/92, thus suitable to perform comparisons with similar areas regularly cultivated in an extensive traditional way. In 13 cases, monitoring was carried out within farmlands entered into F2 schemes, in three cases into F4 schemes; comparison sample areas were identified close (2-7 km) to "enhanced farms" and were characterized by similar habitats, that are extensive agroecosystems with similar characteristics, both agronomic, edaphic, climatic and environmental, but not entered into agri-environment schemes. The farms are placed between 200 and 1100 m a.s.l. Surface of each farmland is, in all cases, more than 10 hectares.

METHODS

Bird census

As bird species numbers provide an indirect index of biodiversity and of agroecosystem quality, monitoring was carried out in spring, as well as in winter. The latter was considered necessary for the aims of this research, Sicily being a favoured wintering area for birds in the Mediterranean, some of which are listed in the Appendix I of Bird Directive 79/409 or within the Spec1-3 and NonSpec^{E},

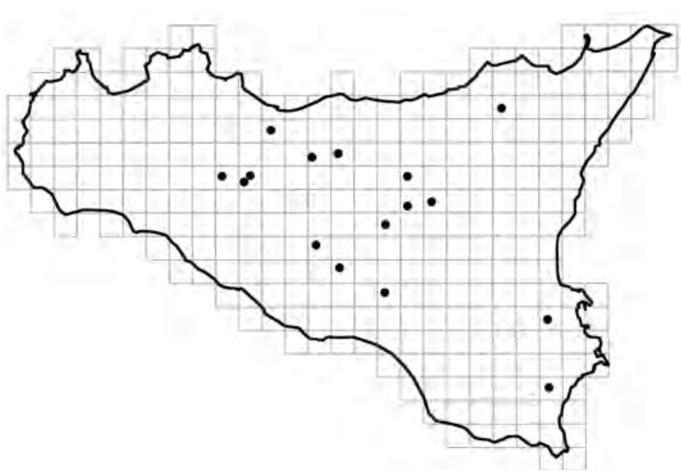

Figure 1. Location of the 16 farms censused in spring and winter (black dots) – *Localizzazione delle 16 aziende agricole censite in primavera e inverno (cerchietti neri).*

Table 2. Results obtained from the point counts in spring and winter within and outside test-farms entered into agri-environment schemes – *Risultati dei censimenti primaverili e invernali all'interno delle aziende campione (interessate dalle misure agro-ambientali) e nelle rispettive aziende di controllo.*

	Spring		**Winter**	
	Within test-farms	Outside test-farms	Within test-farms	Outside test-farms
Total No. of bird species	55	51	49	44
No. of exclusive species	8	4	7	2
No. of species in common	47		42	
Similarity index %	88.7		90.3	
Mean No. of species per farmland	24.25 ± 6.54	22.81 ± 5.31	24.71 ± 5.57	24.86 ± 4.20
Mean No. of species per point count	9.2 ± 2.31	8.3 ± 1.80	10.36 ± 2.95	10.15 ± 2.86
Frequency of occurrence	40.15 ± 11.05	37.78 ± 9.26	42.64 ± 10.05	40.88 ± 10.24
Intrinsic value	8.71 ± 3.23	7.08 ± 2.56	7.63 ± 2.82	6.60 ± 2.16

thus deserving particular attention (BirdLife International 2004). Good habitat quality providing wintering conditions for these species represents an international responsibility and consequently it is important to test if the enforcement of AES of RDR had positive effects on them. This has to be considered a strong point in the final evaluation of its application.

Bird censuses were carried out within farmlands entered into agri-environment schemes, scattered in five provinces of Sicily (Table 1, Figure 1) in the spring 2004 (May-June) and in the winter 2004-2005 (November-February); in winter the survey was carried out from 30 min after sunrise to 1 h before sunset, in good weather conditions; in spring the survey was carried out from 30 min to 5 hours after sunrise. Each farm entered into AES was paired with a nearby conventional farm in order to control for variation in bird communities. Thus, at the same time, that is in the same days when bird census within the farmlands entered into AES (= test-farms) was carried out, the same number of point counts was performed outside the above cited farmlands (= control-farms). These farmlands are placed between two and seven kilometres from the former ones. On the whole 418 point counts (209 within test-farms and 209 within control-farms) were conducted in spring and another 418 in winter, for a total of 836, evenly shared within farmlands entered into AES and outside them. The number of point counts depended on the surface of each farm (Table 1). Every point count consisted in listing all the birds detected during 20 minutes, both observed or heard, to obtain a frequency of occurrence of each species in each farm-type (Blondel 1975, Blondel *et al.* 1981). Generally, standardized and accepted techniques for surveying birds in winter are lacking, bird behaviour in wintering areas often differs from that on breeding grounds, wintering grassland birds sing less, rarely display or engage in other conspicuous behaviour and this may compromise the reliability of census methods (Roberts and Schnell 2006). Notwithstanding, in accordance with our personal experience in the Mediterranean area, in good weather conditions a lapse of time of 20 minutes allows a high detecting probability of most wintering species, thus bird census in winter was carried out with the same method used in spring, but including also birds detected during the displacements from one to the next point count; displacement, indeed, may increase the probability to detect some species, more elusive in winter (e.g. Dunnock *Prunella modularis*, Spectacled Warbler *Sylvia conspicillata*, Rock Bunting *Emberiza cia*). Census of birds were carried out by E. Canale, R. Ientile, R. Lo Duca, B. Massa and M. Siracusa.

Table 3. Bird species detected in spring and winter and similarity of communities – *Ricchezza in specie e indice di similarità tra le comunità censite in primavera e inverno.*

	Spring	**Winter**
Total No. of species (n = 72)	59	51
No. of exclusive species	21	13
No. of species in common	38	
Similarity index (Sorensen)	58.2%	

Statistical analysis

According to BirdLife International (2004), among 524 European species, 226 are assessed as Spec1-3, needing special conservation measures; European Spec1 (n = 40) are species of global conservation concern, Spec2 (n =

45) have unfavourable conservation status and are mainly concentrated in Europe, Spec3 (n = 141) have unfavourable conservation status, but are not mainly concentrated in Europe; furthermore the NonSpec^E (n = 94) have favourable conservation status, but are mainly concentrated in Europe. We gave a "weight" to bird species recorded as Spec1-3 and NonSpec^E, to those listed in the Italian Red List of breeding birds (RL) by LIPU and WWF (1999) and to those reported in the Appendix I of the 79/409 Bird Directive; "intrinsic value" of birds was estimated as follows: Σ (Spec) + (RL) + (79/409), being Spec1 = 1, Spec2 = 0.75, Spec3 = 0.50, NonSpec^E = 0.25, EX (extinct species) = 1, CR (critically endangered) = 0.80, EN (endangered) = 0.60, VU (vulnerable) = 0.40, LR (at lower risk) = 0.20, 79/409 = 1 (Massa *et al*. 2004). When a species has been recorded within a farmland, its intrinsic value was assigned to it; the sum of all values divided by the number of censused farmlands is the intrinsic value of that species in that kind of farmland. We used these values in our comparisons. Another index used was the Sorensen similarity index S = 2c/a+b, where a and b are the total number of species detected in each farm type, c is the total number of species in common in both farm types (the index ranges from 0 to 1 and can be expressed as percentage).

The mean number of bird species per farm was obtained from the point counts within each farm; mean species number per farmland type, instead, was obtained from the means in each farm type. Frequency of occurrence of each species is the mean detected in each kind of farmland, while frequency of occurrence of all the species in each kind of farmland is the mean obtained from the average values in each farm. To test differences between frequencies of species in the farmlands, we omitted from the data those of the following categories: a) species present with a frequency of occurrence lower than 25%. They were considered rare species; even if they contribute to the total richness, have been excluded being concentrated at a relatively small number of sites, and are not representative of the wider countryside (cf. Gregory *et al*. 2004); b) species linked to rural buildings (e.g.: Spotless Starling *Sturnus unicolor*, Spanish Sparrow *Passer hispaniolensis*); c) ubiquitarian species (e.g.: Carrion Crow *Corvus cornix*, Magpie *Pica pica*, as well as two raptors, Kestrel *Falco tinnunculus* and Buzzard *Buteo buteo*) (cf. Table 4). A total amount of 20 species in spring and 17 in winter remained to test statistical differences; differences among test-farm and control-farm communities were performed by the Wilcoxon matched-pairs test (Fowler and Cohen 1993).

In the text "within test-farms" means within farmlands entered into agri-environment schemes, while "outside test-farms" means in control-farms.

Table 4. Alphabetical list of the 18 species detected by point counts with a frequency of occurrence higher than 25% and characterizing Sicilian grasslands in spring and in winter – *Lista in ordine alfabetico delle 18 specie censite mediante punti d'ascolto, la cui frequenza è >25%, e che caratterizzano gli ambienti cerealicoli in primavera e in inverno.*

Alauda arvensis	winter
Anthus pratensis	winter
Carduelis cannabina	spring and winter
Carduelis carduelis	spring and winter
Cisticola juncidis	spring and winter
Coturnix coturnix	spring
Emberiza calandra	spring and winter
Emberiza cirlus	spring and winter
Erithacus rubecula	winter
Fringilla coelebs	winter
Galerida cristata	spring and winter
Hirundo rustica	spring
Motacilla alba	winter
Saxicola torquatus	spring and winter
Streptopelia turtur	spring
Sylvia cantillans	spring
Sylvia melanocephala	spring and winter
Turdus merula	spring and winter

RESULTS AND DISCUSSION

On the whole, 59 bird species were detected in spring, 56 within test-farms (mean: 24.25 ± 6.54; min-max: 11-35; n = 16), 51 outside test-farms (mean: 22.81 ± 5.31; min-max: 10-32; n = 16) (Table 2, Appendix 1). The mean species number per census point resulted 9.21 ± 2.3 (min-max: 6-15; n = 209) within and 8.31 ± 1.8 (min-max: 6-13; n = 209) outside test-farms (Appendix 1). The intrinsic value of birds resulted on average higher within test-farms than outside test-farms (Appendix 1), the difference resulted statistically significant (T = 84.50; Z = 2.10; P = 0.04; df = 58).

In winter, 51 species have been detected, 49 within (mean: 24.7 ± 5.6; min-max: 14-33), 44 outside test-farms (mean: 24.8 ± 4.2; min-max: 18-32), mean species number per point count resulted 10.4 ± 2.95 (min-max: 6.4-16) within and 10.1 ± 2.86 (min-max: 4-15) outside test-farms. Also in winter, the intrinsic value of birds resulted on average higher within than outside test-farms (Appendix 1), even if differences did not result statistically significant (T = 73.00; Z = 0.88; P = 0.38; df = 36). As we will see, there is a remarkable turnover between spring and winter communities, which might be responsible of differences in the intrinsic value of birds. As regards the frequency of occurrence, in spring it resulted as much as 40.15 ± 11.05 within and 37.78 ± 9.26 outside test-farms, while in winter it was 42.64 ± 10.05 within and 40.88 ± 10.24 outside test-farms (Table 2).

Comparison between frequencies of species in spring resulted significantly different (Wilcoxon test: T = 21.00; Z = 3.14; P = 0.002; df = 19). Also in winter we found a significant difference between the communities (T = 13.00; Z = 3.01; P = 0.003; df = 16). Being values obtained within test-farms generally higher than those outside test-farms, we assumed that comparing pairs of data within/outside test-farms, we could find a good correlation among them; as matter of fact, they resulted as follows: in spring (n = 30), total number of species: Spearman r = 0.526; P = 0.037; mean number of species: r = 0.743; P = 0.001; frequency of occurrence: r = 0.871; P < 0.001; in winter (n = 30), total number of species: r = 0.809; P < 0.001; mean number of species: r = 0.818; P < 0.001; frequency of occurrence: r = 0.895; P < 0.001. Additionally, a significant correlation between the species number per farmland and their ornithological intrinsic value has been detected both in spring (r = 0.4, df = 30, P < 0.02) and in winter (r = 0.763, df = 30, P < 0.001); this means that where there is a higher number of species, bird community is richer in priority species.

Finally, similarity between communities detected in spring within and outside test-farms resulted 88.7%, while in winter resulted to be as much as 90.3% (Table 2). Between the seasons there is an important turnover of communities (Tables 2, Appendix 1), namely 72 species were recorded on the whole, but 13 winter species resulted absent in spring, while 21 spring species were absent in winter, with a high turnover, as the similarity index between spring and winter communities (58.2%) points out (Table 3). Some species showing frequency values rather high in winter, are scarce, rare or absent in spring (e.g.: Skylark *Alauda arvensis*, White Wagtail *Motacilla alba*, Blackcap *Sylvia atricapilla*, Chaffinch *Fringilla coelebs*, Blackbird *Turdus merula*); this depends on two main reasons: 1) in winter some species change their behaviour and exploit agroecosystems more than in spring; 2) in winter numbers of some species increase markedly due to the wintering flow of central European populations. This is an important aspect and allows to highlight the major role played by southern areas of the Mediterranean basin for the conservation of some European species, and in particular by Sicily for the conservation of consistent central European populations of different species of Fringillidae there wintering.

Overall, in spring 40 (67.8%) out of 59 species showed a frequency of occurrence higher within than outside test-farms. Species characterizing communities were more or less the same within and outside test-farms, with some exceptions. In our list, even the Barn Owl *Tyto alba* is missing, it is a very common and widespread species in Sicilian farmlands, but entirely nocturnal. Conversely, among so many areas examined through Sicilian grasslands, the Calandra Lark *Melanocorypha calandra*, a breeding species in decline in the last years and in danger of extinction in Sicily (AAVV 2008), was never recorded. Within test-farms species with a high intrinsic value resulted more frequent than outside test-farms, while the opposite has not been observed; among them Woodchat Shrike *Lanius senator*, Short-toed Lark *Calandrella brachydactyla*, Lesser Kestrel *Falco naumanni*, Quail *Coturnix coturnix* and Turtle Dove *Streptopelia turtur*. Outside test-farms frequency values of these species are not balanced by other "priority" species. According to Massa and La Mantia (2007), 24.5% of terrestrial birds breeding regularly in Sicily are linked to grasslands, most of them living or using this habitat secondarily; within 59 breeding species listed in Appendix 1, 12 have increasing, 36 stable and 11 decreasing populations (Massa *et al.* 2008). Thus, we may reasonably consider grasslands as a very important habitat for Mediterranean birdlife, as pointed out in central Europe by several authors.

In winter 31 (61%) out of 51 species detected on the whole, showed a frequency of occurrence higher within than outside test-farms. Species characterizing communities were also in winter more or less the same within and outside test-farms, with some exceptions. Within test-farms, species with high intrinsic value resulted more frequent than outside test-farms, namely the Skylark *Alauda arvensis*, Rock Partridge *Alectoris graeca*, Stone-curlew *Burhinus oedicnemus* and Woodlark *Lullula arborea*; outside test-farms frequency values of these species are not balanced by other "priority" species.

On the whole, 72 species of birds were detected on Sicilian farmlands; interestingly, 13 of them are listed in the Appendix I of the Bird Directive, 27 have unfavourable status in Europe, namely: one lies within Spec1, seven within Spec2, and 20 within Spec3; moreover, 21 species are NonSpec^{E}, that is they have favourable status, but are concentrated in Europe, while the remaining 23 are NonSpec. One species is listed as extinct breeder in the Italian Red List, three are endangered, three are vulnerable and eight are at lower risk. Overall, 18 species of birds may be reasonably considered as characterizing Sicilian grasslands (Tab. 4), of which only 9 (50%) are present both in breeding and winter seasons. Bird list of Table 4 was obtained following a similar methodology to that used for the British Bird Index, developed to complement indicators measuring the state of species and habitats of particular conservation value; rare birds were excluded because they are mostly the focus of dedicated conservation action, concentrated at a relatively small number of sites, and not representative of the wider countryside (Gregory *et al*. 2004).

Granivorous species find within Sicilian grasslands a good feeding opportunity for the winter, in particular on ploughed lands, due to the high seed availability. Many farmland birds rely largely on seeds in the winter months, a critical season for them; an objective of some options of agri-environment schemes is to encourage seeding weeds on arable land as a source of seed food for birds in winter; to increase granivorous wintering species, it should be sufficient to plough a modest percentage of set aside grasslands, as suggested by Robinson *et al*. (2004).

Results obtained with the intrinsic value of species deserves also some considerations; it takes into account the weight of each species according to their conservationist significance. Highest values were obtained from communities detected within test-farms, that is entered into AES, and spring communities resulted richer in "priority" species than winter ones. In accordance with the results obtained during this research, we stress the importance to guarantee at least some fragments of natural habitats to sustain vital animal populations, to link remnants of natural habitats through an improvement of agroecosystems within ecological corridors, and to favour habitat mosaics to guarantee different species requirements during their complete vital cycle.

CONCLUDING REMARKS

Trends of farmland bird species has been adopted as a sustainable development indicator of the EU, as part of the assessment of the EU Sustainable Development Strategy. Comparisons of bird communities on organic and conventional farms in Denmark, The Netherlands and Britain suggest that organic farms support higher breeding and wintering densities of a wide range of species than conventional farms nearby; the reason seems due to a range of factors, rotations, mixed arable and livestock regimes, very limited pesticide usage and more extensive non-cropped habitat, as well as increased food availability in organic compared with conventional cereals (Vickery *et al.* 2002, Kragten *et al.* 2008, Wrbka *et al*. 2008). Farmer motivation and expertise may determine the extent of delivery of environmental benefits (Vickery *et al.* 2004a). Báldi *et al.* (2005) found in Hungary that bird species showed rather complex, often contrasting responses to grazing intensity and agree with Kleijn and Sutherland (2003), who consider that AES are successful, and act for the benefit of wildlife, if the target is clearly defined in an operative way, and they are closely supervised by scientists. Recently, a wide consensus emerged that the conservation of the farmland environment, of which birds form a high profile part, shall be obtained through a number of measures operating at different political and spatial scales (Nagy 2005). Following the Commission of the European Communities (2005), biodiversity conservation is a decisive factor in agricultural activities.

Results of this study suggest that AES may be the right track; the direction for future farmland biodiversity research should be to investigate the close relationships between agricultural land use and animal populations, in particular the influence of management practices on survival rates of bird populations, year-round ranging behaviour of farmland birds to verify the temporal and spatial exploitation of cropped and non-cropped habitats and the relationships between farmland and non farmland populations of each species. Distribution of species on farmland vary noticeably in time; many bird species, even if not strictly linked to farmlands, outside the breeding season, may depend for food on this habitat. Extensive agriculture plays an important role in biodiversity conservation, because it involves wide areas of semi-natural habitats, as grasslands or pseudo-steppes, housing some endangered or rare species of fauna and flora. This is particularly true in Europe, where many species evolved through thousands of years and still live over a landscape shaped by farmers; where extensive systems remained unaltered for many centuries, very rich and diversified plant and animal communities developed, today representing main evidences of European biodiversity (Cunningham *et al*. 2004). However, many extensive Mediterranean farmlands have been managed with intensive methods, particularly with high chemical inputs, such as fertilizers and herbicides. This is the possible reason for which we found differences between bird communities on farmlands entered into AES and those living on conventional farmlands; total renouncement of agrochemicals during critical periods is the possible reason of observed differences.

We may conclude that in Sicily enforcement of AES contributed in a way to maintaining biodiversity, and possibly future agreements will further increase this aim. Cunningham *et al*. (2004) believe that farmland bird decline is an Europe-wide problem that requires Europe-wide solutions. We agree very much with their opinion and with what wrote de la Concha (2005), that the rural development reforms planned for the 2007-2013 period appear to be an opportunity to resolve some environmentally harmful effects arisen from the measure application in the previous period; in particular, agri-environment measures, rewarding farmers improve farmland with land able to provide food, shelter and nesting sites for wildlife, should be better designed, more competitively funded and paid in accordance with the importance of the environmental benefits provided.

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Appendix 1. Alphabetical list of the species detected in spring and winter, recording if they are listed in the Appendix I of Bird Directive 409/79 (*), their European status (after BirdLife International 2004), the presence in the Italian Red List (after LIPU and WWF 1999). Mean intrinsic value is drawn from previous data (cf. methods); frequencies of occurrence in spring and winter within and outside test-farms entered into agri-environment measures were obtained from point counts (cf. methods). IV, intrinsic value; wtf, within test-farms; otf, outside test-farms; FP, % Frequency – *Lista in ordine alfabetico delle specie censite in primavera ed in inverno. È indicato altresì se la specie è inclusa nell'App. I della Direttiva CE 409/79 (*), il suo status a livello europeo secondo BirdLife International (2004), l'eventuale inclusione nella Lista Rossa italiana (LIPU e WWF 1999). Il valore intrinseco medio (IV) è ricavato dai dati precedenti (cfr. metodi); le frequenze primaverili e invernali (FP) all'interno (wtf) e al di fuori (otf) delle aziende campione sono ricavate dai censimenti (cfr. metodi).*

Species	IV	Spring				Winter			
		IV wtf	IV otf	FP wtf	FP otf	IV wtf	IV otf	FP wtf	FP otf
Alauda arvensis Spec3	0.5	0.13	0	6.1	0	0.43	0.39	57.4	40.7
*Alectoris graeca** Spec2, VU	2.15	0.13	0	0.9	0	0.31	0	1.9	0
*Anthus campestris** Spec3	1.5	0.06	0.06	3.2	2.5	absent	absent	absent	absent
Anthus pratensis NonSpec[E]	0.25	absent	absent	absent	absent	0.21	0.20	40.9	40.2
Apus apus NonSpec	0	0	0	38.0	48.4	absent	absent	absent	absent
Apus melba NonSpec, LR	0.2	0.01	0	1.4	0	absent	absent	absent	absent
Apus pallidus NonSpec, LR	0.2	0.05	0.01	3.9	0.5	absent	absent	absent	absent
Ardea cinerea NonSpec, LR	0.2	absent	absent	absent	absent	0	0.01	0.6	0.7
Athene noctua Spec3	0.5	0.22	0.19	4.6	4.4	0.18	0.11	5.5	3.3
*Burhinus oedicnemus** Spec3, EN	2.1	0.13	0	1.4	0	0.15	0	1.7	0
Buteo buteo NonSpec	0	0	0	18.1	15.5	0	0	26.6	20.4
*Calandrella brachydactyla** NonSpec[E]	1.5	0.66	0.09	13.4	1.4	absent	absent	absent	absent
Carduelis cannabina Spec2	0.75	0.47	0.48	24.0	26.8	0.64	0.70	38.1	39.2
Carduelis carduelis NonSpec	0	0	0	59.4	54.7	0	0	70.8	74.3
Carduelis chloris NonSpec[E]	0.25	0.03	0.02	2.0	0.4	0.02	0.02	0.6	1.7
Cettia cetti NonSpec	0	0	0	2.4	3.9	0	0	6.7	10.0
*Ciconia ciconia** Spec2, LR	1.95	0	0.31	0	0.4	absent	absent	absent	absent
*Circus cyaneus** Spec3, EX	2.5	absent	absent	absent	absent	0.54	0.54	1.7	4.7
*Circus pygargus** NonSpec[E], VU	1.65	0	0.10	0	0.4	absent	absent	absent	absent
Cisticola juncidis NonSpec	0	0	0	57.0	61.9	0	0	24.0	22.9
Columba livia NonSpec, VU	0.4	0.18	0.23	7.0	16.7	0.23	0.31	21.8	30.2
Columba palumbus NonSpec[E]	0.25	0.20	0.17	39.3	22.8	0.20	0.13	32.8	22.7
*Coracias garrulus** Spec2, EN	2.35	0.15	0.15	0.9	0.6	absent	absent	absent	absent
Corvus corax NonSpec, LR	0.2	0.05	0.05	3.9	6.7	0.09	0.11	5.8	9.0
Corvus cornix NonSpec	0	0	0	38.0	54.0	0	0	66.7	75.7
Corvus monedula NonSpec[E]	0.25	0.08	0.09	6.3	7.6	0.09	0.09	10.8	7.9
Coturnix coturnix Spec3, LR	0.7	0.57	0.35	33.7	20.6	absent	absent	absent	absent
Cyanistes caeruleus NonSpec[E]	0.25	0.09	0.08	6.8	3.5	0.09	0.11	7.9	7.9
Delichon urbicum Spec3	0.5	0.06	0.09	1.7	1.4	absent	absent	absent	absent
Emberiza calandra Spec2	0.75	0.70	0.70	68.7	64.2	0.64	0.70	48.1	44.9
Emberiza cia Spec3	0.5	0.03	0.03	3.2	1.4	0.02	0.04	3.3	0.6
Emberiza cirlus NonSpec[E]	0.25	0.16	0.17	41.4	23.9	0.18	0.14	22.3	17.2
Erithacus rubecula NonSpec[E]	0.25	absent	absent	absent	absent	0.25	0.23	78.3	67.1
*Falco biarmicus** Spec3, EN	2.1	0	0	0	0	0.15	0	0.8	0

continued

Species	IV	Spring				Winter			
		IV wtf	IV otf	FP wtf	FP otf	IV wtf	IV otf	FP wtf	FP otf
*Falco naumanni** Spec1, LR	2.2	0.41	0.14	7.6	0.9	absent	absent	absent	absent
Falco tinnunculus Spec3	0.5	0.31	0.44	13.1	31.9	0.46	0.43	34.4	27.2
Fringilla coelebs NonSpec[E]	0.25	0.05	0	3.9	0	0.25	0.25	70.0	58.6
Galerida cristata Spec3	0.5	0.44	0.50	91.7	98.9	0.43	0.50	83.1	79.0
Garrulus glandarius NonSpec	0	0.15	0	4.8	0.7	0	0	15.7	14.4
Hirundo rustica Spec3	0.5	0.38	0.44	46.0	37.3	absent	absent	absent	absent
Jynx torquilla Spec3	0.5	absent	absent	absent	absent	0.04	0	0.8	0
*Lanius collurio** Spec3	1.5	0.06	0	0.2	0	absent	absent	absent	absent
Lanius senator Spec2, LR	0.95	0.36	0.18	9.3	3.6	absent	absent	absent	absent
*Lullula arborea** Spec2	1.75	0.55	0.55	14.6	11.5	0.75	0.50	10.6	7.5
Luscinia megarhynchos NonSpec[E]	0.25	0.11	0.03	15.2	1.9	absent	absent	absent	absent
Merops apiaster Spec3	0.5	0.19	0.19	10.9	11.5	absent	absent	absent	absent
Motacilla alba NonSpec	0	0	0	0	1.4	0	0	36.8	36.8
Motacilla cinerea NonSpec	0	0	0	0	0	0	0	0	1.2
Oenanthe oenanthe NonSpec	0	0	0	8.7	4.2	absent	absent	absent	absent
Parus major NonSpec	0	0	0	9.5	5.4	0	0	19.3	20.7
Passer hispaniolensis NonSpec	0	0	0	55.4	69.4	0	0	55.0	71.5
Passer montanus Spec3	0.5	0.03	0.09	0.9	2.5	0.11	0.11	4.2	6.7
Petronia petronia NonSpec	0	0	0	11.3	2.7	0	0	5.4	4.2
Phoenicurus ochruros NonSpec	0	0	0	2.9	0	0	0	7.3	15.8
Pica pica NonSpec	0	0	0	33.8	47.0	0	0	61.4	86.3
Prunella modularis NonSpec[E]	0.25	absent	absent	absent	absent	0.02	0	0.8	0
*Pyrrhocorax pyrrhocorax** Spec3, VU	1.9	0.12	0	3.8	0	0.14	0	6.1	0
Saxicola torquatus NonSpec	0	0	0	41.1	37.0	0	0	49.1	45.6
Serinus serinus NonSpec[E]	0.25	0.11	0.13	11.1	11.2	0.18	0.14	18.3	12.5
Streptopelia turtur Spec3	0.5	0.38	0.28	33.2	22.0	absent	absent	absent	absent
Sturnus unicolor NonSpec[E]	0.25	0.17	0.22	26.2	20.0	0.20	0.21	28.9	41.0
Sturnus vulgaris Spec3	0.5	absent	absent	absent	absent	0.07	0.11	7.5	11.7
Sylvia atricapilla NonSpec[E]	0.25	0	0	0	0	0.13	0.09	23.5	18.1
Sylvia cantillans NonSpec[E]	0.25	0.17	0.14	31.1	9.2	absent	absent	absent	absent
Sylvia communis NonSpec[E]	0.25	0.06	0.05	4.4	5.1	absent	absent	absent	absent
Sylvia conspicillata NonSpec	0	0	0	4.8	5.1	0	0	0.6	0
Sylvia melanocephala NonSpec[E]	0.25	0.16	0.17	37.5	29.3	0.18	0.21	43.4	42.2
Troglodytes troglodytes NonSpec	0	0	0	0	0	0	0	0.8	0.8
Turdus merula NonSpec[E]	0.25	0.17	0.16	28.2	20.6	0.21	0.20	45.5	39.8
Turdus philomelos NonSpec[E]	0.25	absent	absent	absent	absent	0.07	0.02	5.8	0.8
Turdus pilaris NonSpec[E]	0.25	absent	absent	absent	absent	0	0.02	0	0.8
Upupa epops Spec3	0.5	0.19	0	9.2	3.8	absent	absent	absent	absent
Total species (n = 72)	-	-	-	56	51	-	-	49	44
∑ Frequency of occurrence	-	-	-	1058	950	-	-	1209	1185
Total intrinsic value	40.75	14.33	11.48	-	-	12.46	11.02	-	-