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ARE THE CONSERVATION REQUIREMENTS OF PSEUDO-STEPPE BIRDS ADEQUATELY COVERED BY SPANISH AGRI-ENVIRONMENTAL SCHEMES? AN *EX-ANTE* ASSESSMENT

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SUMMARY.—*Are the conservation requirements of pseudo-steppe birds adequately covered by Spanish agri—environmental schemes? An ex-ante assessment.*

Aims: To assess *ex-ante* the adequacy of available agri-environmental schemes towards the agriculture-related conservation requirements of pseudo-steppe birds and their habitats in Spain.

Methods: A literature review was made on these requirements, based on which 21 «desirable agricultural practices» were identified. National and regional legislative acts implementing schemes under the 2000-2006 programme as in December 2003 were then collected, and the degree to which these desirable practices had been included among the schemes' commitments was determined. The percentage of included desirable practices was considered an indication of the schemes' adequacy towards the conservation requirements of pseudo-steppe birds. Schemes were also assessed in regards to their provisions for spatially targeted implementation.

Results and Conclusions: Only 71% of identified desirable practices are included as commitments to farmers at the national level. Implementation deficit at the regional level diminishes this figure at an average 39%, with extreme cases at 0 % and 67 %. Further, schemes' implementation is generally not targeted to particular sites of special conservation interest, such as Special Protection Areas (Birds Directive). On the basis of encountered design deficiencies and limited implementation, it is concluded that limited effects in terms of pseudo-steppe birds' conservation can be expected from current agri-environmental schemes in Spain. Further, it is argued that detected implementation deficits may be seriously impeding a needed learning-from-doing process in the agri-environment policy arena, an issue of capital importance in the actual context of the European Common Agricultural Policy.

Key words: pseudo-steppe birds, conservation, agri-environment policy, *ex-ante* assessment, Spain.

RESUMEN.—*¿Cubren las medidas agroambientales adecuadamente los requerimientos de conservación de las aves pseudo-esteparias en España? Una evaluación ex-ante.*

Objetivos: Evaluar *ex-ante* la adecuación de las medidas agroambientales disponibles de cara a los requerimientos de conservación relacionados con las prácticas agrarias de las aves pseudo-esteparias y sus hábitats en España.

Métodos: Sobre la base de una revisión de la literatura científica acerca de estos requerimientos, se identificaron 21 «prácticas agrarias deseables». Posteriormente, fueron recopilados los actos legislativos sobre medidas agroambientales del programa 2000-2006 promulgados en los niveles nacional y regional hasta diciembre de 2003, y se determinó el grado en el cuál los requisitos planteados en las medidas incluían estas prácticas deseables. El porcentaje de prácticas deseables incluidas fue considerado indicativo del grado de adecuación de las medidas a los requerimientos de conservación de las aves pseudo-esteparias. También se analizaron las estipulaciones contenidas en las medidas respecto a su aplicación espacialmente localizada.

Resultados y Conclusiones: Sólo un 71% de las prácticas agrarias deseables identificadas están incluidas en el nivel nacional como obligaciones para los agricultures. El déficit en la aplicación del programa a nivel regional disminuye la adecuación del mismo, con una variación entre regiones entre el 0% y el 67%. Además, las medidas se aplican generalmente sin estipulación de ámbitos espaciales particularizados en función del interés de conservación, como las Zonas de Especial Protección para las Aves (Directiva Aves). Sobre la base de las deficiencias de diseño y de la limitada aplicación de las medidas actuales, se concluye que cabe esperar limitados efectos de su aplicación en términos de conservación de las aves pseudo-esteparias. Finalmente se argüye que los déficits de aplicación detectados pueden estar impidiendo el necesario proceso de experiencia-aprendizaje en el tema agroambiental, considerado de capital importancia en el contexto actual de la Política Agraria Común europea.

Palabras clave: aves pseudo-esteparias, conservación, medidas agroambientales, evaluación *ex-ante*, España.

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INTRODUCTION

Pseudo-steppe birds and their habitats have been a main target of Spanish agri-environmental schemes since its inception in 1993 (Peco *et al*., 2002). The first agri-environmental programme, 1993-1999, included up to 21 specific schemes with particular objectives towards birds' conservation in extensive cereal crops (Oñate *et al*., 1998), reflecting both the importance of this agricultural system in the country (47% of arable land; MAPA, 1995), and the remarkable conservation interest of bird communities inhabiting the cereal pseudo-steppes (Suárez *et al*., 1997a). Although never published in detail, implementation results of this programme show how more than 24,000 participants used around 625,000 ha in schemes on production extensification and flora and fauna protection in extensive cereal systems, with an overall expenditure of 61.2 million euros (MAPA, *pers. obs*.).

Unfortunately, *ex-post* analysis of agri-environment schemes' effects on biodiversity using 'state' indicators (OECD, 1999) is still lacking in Spain, as it is in the remaining Mediterranean countries (Kleijn & Sutherland, 2003). In spite of conclusive (and contradictory) results elsewhere in Europe (*e.g*., Kleijn *et al*., 2001, 2003; Peach *et al*., 2001), methodological caveats have been argued against the exclusive use of environmental characteristics (*e.g*., species diversity, abundance or density) as unique indicators for attributing such effects to agri-environment policy (Peco *et al*., 1999). However, research based on 'driving force' indicators (related to the agricultural practices that the schemes aim to affect) has not offered conclusive results with regard to effects of schemes targeting extensive cereal systems (Prindahl *et al*., 2003), apart from partial evidence for improvement effects of one regional scheme in Spain (Oñate *et al*., 2000).

Under these circumstances, *ex-ante* evaluations (Rossi *et al*., 1999) could offer the most valuable insights on the potential effectiveness of agro-environment schemes with regard to biodiversity conservation. Although considered as part of the planning phase of any intervention programme (European Commission, 2002), this type of assessment is particularly appropriate as a mid-term evaluation of the Spanish new agri-environment programme 2000-2006 (MAPA, 2000). The programme is a collection of more than 90 varied schemes for voluntary and independent adoption by farmers. In principle, implementation is not targeted to particular spatial ambits (i.e. «horizontal»), as any farmer is eligible provided that scheme's agronomic criteria are met. According to the decentralised political structure of the country, regional authorities, fully competent in agricultural matters, decide on which schemes they implement among those in the national programme, and may introduce a spatially targeted implementation. Therefore, the programme's overall potential effectiveness depends not only on the concrete design of prescriptive commitments to participating farmers, but also on the variable implementation degree of schemes by the different regions and the targeting options they might have adopted.

This paper presents an *ex-ante* evaluation of the design and potential effectiveness of the Spanish agri-environmental programme 2000-2006 based on the adequacy of available schemes and their commitments towards the agriculture-related conservation requirements of pseudo-steppe birds and their habitats in Spain.

APPROACH

On the one hand, scientific published information on agriculture-related conservation requirements of pseudo-steppe birds in Spain has been reviewed. Individual species and bird communities, as well as impacts from agricultural practices and land use conforming optimal habitat structure, were the focus of this review. Identified agriculture-related conservation requirements of pseudo-steppe birds have been expressed in terms of 21 «desirable» agricultural practices, related to land use or to management issues.

On the other hand, legislative acts on agri-environmental schemes enacted by National administration and selected regions before December 2003 and developing the 2000-2006 programme were reviewed (see Appendix 1). Ten out of 15 regions in peninsular Spain were selected for the analysis. In these regions, the share of utilised agricultural area occupied by dry cereal crops, leguminous crops and fallow land is higher than 10%, 0.5% and 5%, respectively (INE, 2000). A mosaic combination of

these cultivated surfaces (together with dry pastures) is characteristic of the optimum habitat in the pseudo-steppes (Suárez *et al*., 1997a).

The adequacy of agri-environmental schemes towards pseudo-steppe birds' conservation was expressed as the percentage of desirable practices included among the schemes' commitments. Total adequacy (100%) would be reached if all 21 desirable practices appeared as commitments to participating farmers. The assessment was carried out both at the national and regional implementation levels, although at the latter adequacy depends primarily on the varying number of schemes actually implemented by each region.

Finally, it was also checked whether the regions have further targeted the schemes' eligible spatial ambit beyond the «horizontal» or non-targeted approach of the national programme.

Desirable practices related to land use

Cereal crop is an essential breeding and feeding habitat, but short-cycle cereal varieties are inadequate due to its earlier growing phenology (crop height has been negatively related with birds' presence) and earlier harvest date (potentially causing nest destruction). Further, inter-cropping periods tend to be reduced, which contributes to habitat homogenisation (Guadalfajara & Tutor, 1987; Martínez, 1994; Etxebarría & Astraín, 1998; Suárez *et al*., 2002; Suárez *et al*., 2003). A desirable practice would be: *not to use short-cycle cereal varieties*.

Stubble favours granivorous species, which feed on grain lost from harvest during post-breeding period. Great Bustard *Otis tarda* positively selects stubbles throughout the year (Peris *et al*., 1992; Morgado & Moreira, 2000; Lane *et al*., 2001). Desirable practices would be: *to maintain stubble on parcels to be sown until dates to be regionally determined*, and, *to maintain stubble on parcels to be left in fallow until dates to be regionally determined*.

Fallow land is an essential substrata during breeding and winter seasons for a variety of species (Martínez, 1994; Suárez *et al*., 1997b; Herranz & Suárez, 1999; Santos, 2000; Morales & Martín, 2002), being particularly positive the presence of fallows of different age (Martínez & De Juana, 1996). A desirable practice would be: *to introduce short-medium-term fallow (1 to 5 years) in the rotation*.

Leguminous crops are positively selected by species such as Pin-tailed Sandgrouse *Pterocles alchata*, Little Bustard *Tetrax tetrax* and Great Bustard, during breeding and winter seasons (Martínez, 1994; Herranz & Suárez, 1999; Morales & Martín, 2002). A desirable practice would be: *to introduce pulse and fodder leguminous crops in the rotation*.

Pasture is an important feeding and nesting habitat for certain species (Herranz & Suárez, 1999; Santos, 2000; Martínez, 2000), being also important during winter season (Tellería, 1988; Suárez et al., 1997b; Suárez *et al*., 2003). A desirable practice would be: *not to plough up permanent pastures*.

Uncultivated field borders are important features during nesting and chick feeding periods for certain species, such as the Great Bustard (Morales & Martín, 2002). Lesser Kestrel *Falco naumanni* particularly feeds on those of significant width (Donázar *et al*., 1993, Tella *et al*., 1998). Desirable practices would be: *to maintain uncultivated field borders and their vegetation*, and, *to create new field borders or increase their width*.

Wetlands and other water points are used by a variety of species (Bernáldez *et al*., 1985; Herranz & Suárez, 1999). A desirable practice would be: *to preserve perimeter areas of wetlands without cropping*.

Desirable practices related to management

Phytosanitary use diminishes species richness and abundance of both invertebrate and weed species, reducing trophic resources available to birds (Rands, 1986; Hellmich, 1992; Negro *et al*., 1993; Andreasen *et al*., 1996; Tella *et al*., 1998). Desirable practices would be: *to reduce phytosanitary doses*, *to employ only low-toxicity products (type AAA or AAB)*, *not to apply phytosanitaries on stubble and fallow land*, and, *not to employ chemically treated seeds or only with low-toxicity products (type AAA or AAB)*.

Fertilisers' use encourages earlier and higher growth of cereals, with negative consequences similar to short-cycle cereal varieties (Guadalfajara & Tutor, 1987; Martínez, 1994;

Etxebarría & Astraín, 1998; Suárez *et al*., 2002; Suárez *et al*., 2003). A desirable practice would be: *to reduce fertiliser doses*.

Ploughing of fallow surfaces during non-crop period reduces available breeding habitat for pseudo-steppe birds (Martínez, 1994; Suárez *et al*., 1997b; Herranz & Suárez, 1999; Santos, 2000; Morales & Martín, 2002). A desirable practice would be: *not to plough fallows during breeding and nesting periods*.

Harvest operations. Earlier cereal harvest and night harvest negatively affect the reproductive success of different species (Calvo, 1994; Arroyo *et al*., 2002). Instead, early and repeated mowing of leguminous crops (such as luzerne) favours the presence of pseudo-steppe species (García de la Morena, *pers. obs*.), which avoid parcels where these grow tall (Guadalfajara & Tutor, 1987; Martínez, 1994; Etxebarría & Astraín, 1998; Suárez *et al*., 2002; Suárez *et al*., 2003). Desirable practices would be: *not to harvest during night*, *to delay harvest operations depending on the breeding phenology of the species*, and, *to mow leguminous crops twice before the breeding period*.

Grazing of pastures and set-aside land maintains favourable microhabitat structure and seed accessibility for pseudo-steppe species, which are negatively affected by scrub encroachment following abandonment (Díaz & Tellería,1994; Tella *et al*., 1998; Santos, 2000; Suárez-Seoane *et al*., 2002). Desirable practices would be: *to promote grazing on permanent pastures, stubble and fallow land*, *to mechanically clear scrub on affected parcels*, and, *to maintain set-aside land in good agricultural condition*.

Adequacy assessment

Out of the 21 desirable practices identified as potential agri-environmental commitments for the conservation of pseudo-steppe birds, only 15 were present as such among the different schemes in the National programme (Table 1). Therefore, 29% of desirable practices have not been included, lowering adequacy of the National programme towards pseudo-steppe birds' conservation at 71%.

In their implementation of the agri-environmental programme, the regions have included as commitments an average 39% of desirable practices (Table 1). There was, however, considerable variability among regions, with Castilla-La Mancha and Extremadura at one extreme with 0% adequacy, and Aragón and La Rioja at the other with adequacy 67% (Fig. 1).

A majority of regions (80%) have not included any disposition towards targeting schemes' implementation. Only Aragón and Madrid restricted eligibility to those farmers inside zones declared as Bird Special Protection Areas (SPA, Birds Directive) and as Sites of Community Interest (SCI, Habitats Directive), while La Rioja introduced the presence of extinction-endangered species in the farms as eligibility criterion for some schemes.

Discussion

Neither the importance of Spanish agricultural mosaics for pseudo-steppe birds' communities (Tucker & Evans, 1997; Suárez *et al*., 1997a) or the negative recent trends experienced by most typical species (De Juana, 2004), find a satisfactory reflection in the assessed agri-environmental programme. Both design deficiencies and implementation deficits are behind this shortage.

Deficiencies of the schemes' design are found, firstly, in the detected absence of 29% of those desirable practices that could have been included in the National programme as commitments to participating farmers. Absent practices, such as «not to use short-cycle cereal varieties», «not to plough-up permanent pastures», «to create new field borders or increase their width», «to preserve breeding periods out of leguminous' mowing operations», or «to preserve perimeter areas of wetlands without cropping», all have been pointed out as important elements configuring the optimal habitat for pseudo-steppe species. Its inclusion as agri-environmental commitments would clearly benefit spatial and temporal habitat heterogeneity (Benton *et al*., 2003), contributing to the enhancement of the potential effectiveness of schemes in terms of biodiversity conservation.

Certainly, our approach bears limitations derived from the fact that the 'desirable practices' are defined on the basis of available (incomplete) information on wildlife-habitat relationships, which are scale-dependent (*e.g*., Wiens *et al*., 1987). Would it be the case that

TABLE 1

Adequacy of Spanish agri-environment schemes (programme 2000-2006) towards pseudo-steppe birds' conservation requirements, in terms of percentage of desirable practices included as commitments, both at National (schemes' codes are indicated) and Regional (dots indicate at least one of the previous schemes implemented in that region) levels.
[Adecuación de las medidas agroambientales españolas (programa 2000-2006) a las necesidades de conservación de las aves pseudo-esteparias, en términos del porcentaje de prácticas deseables recogidas como obligaciones en las medidas, tanto a nivel nacional (se indican los códigos de las medidas), como regional (los puntos indican la aplicación en cada región de alguna de las medidas anteriores).]

Desirable practices *[Prácticas deseables]*	Schemes [1] *[Medidas [1]]*	Regions [2] *[Regiones [2]]*									
		1	2	3	4	5	6	7	8	9	10
Related to land use *[Relacionadas con el uso del suelo]*											
To maintain uncultivated field borders and their vegetation *[Mantener lindes entre campos y su vegetación]*	1.2, 3.1.1, 3.2.1, 4.2, 4.3, 8.1	•	•	•	•	•	•		•		
To maintain stubble on parcels to be swon *[Mantener el rastrojo en las parcelas para siembra]*	1.1, 1.2, 9.1.1	•	•	•	•	•	•	•			
To maintain stubble on parcels to be left in fallow *[Mantener el rastrojo en las parcelas para barbecho]*	1.1	•	•	•	•	•	•	•			
To introduce short-medium-term fallow in the rotation *[Introducir barbechos de corto y medio plazo en la rotación]*	1.1, 1.1.2, 1.4.1	•	•	•	•	•		•			
To introduce pulse and fodder leguminous crops in the rotation *[Introducir leguminosas grano y forrajeras en la rotación]*	1.2.1	•	•		•	•	•				
Not to use short-cycle cereal varieties *[No utilizar variedades de cereal de ciclo corto]*	—										
Not to plough-up permanent pastures *[No roturar pastizales permanentes]*	—										
To create new field borders or increase their width *[Crear nuevas lindes entre campos o incrementar su anchura]*	—										
To preserve perimeter areas of wetlands without cropping *[Preservar de cultivo áreas perimetrales a los humedales]*	—										

(Continúa)

TABLE 1 (Continuación)

Desirable practices *[Prácticas deseables]*	Schemes (1) *[Medidas (1)]*	Regions (2) *[Regiones (2)]*									
		1	2	3	4	5	6	7	8	9	10
Related to land use *[Relacionadas con la gestión]*											
Not to apply phytosanitaries on stubble and fallow land *[No aplicar fitosanitarios sobre rastrojos o barbechos]*	1.1, 1.4.1	•	•	•	•	•	•	•			
Not to harvest during night *[No cosechar durante la noche]*	1.1	•	•	•	•	•	•	•			
Not to use chemically treated seeds or only with low-toxicity products *[No usar semillas blindadas o sólo con productos de baja toxicidad]*	1.2, 5.3	•	•	•	•	•	•				
To graze permanent pastures, stubble, and fallow land *[Pastoreo de pastos permanentes, rastrojos y barbechos]*	1.1, 8.1, 9.1.1	•	•	•	•	•		•			
To employ only low-toxicity products (type AAA or AAB) *[Emplear sólo productos de baja toxicidad (tipo AAA o AAB)]*	3.1.1, 3.2.1	•	•	•			•		•		
To delay harvest operations out of the species' breeding period *[Retrasar la cosecha fuera del periodo de cría de las especies]*	1.2	•	•	•	•	•					
To reduce phytosanitary doses *[Reducir las dosis de fitosanitarios]*	3.1.1, 3.2.1	•	•	•					•		
To reduce fertiliser doses *[Reducir las dosis de fertilizantes]*	3.1.1, 3.2.1	•	•	•					•		
To maintain set-aside land in good agricultural condition *[Mantener en buen estado las tierras abandonadas]*	1.4.1, 4.3	•	•	•							
Not to plough-up fallows during bredding and nesting periods *[No labrar los barbechos durante el periodo reproductivo]*	4.2				•		•				
To mow leguminous crops twice before the breeding period *[Hacer dos siegas de leguminosas antes del periodo de cría]*	—										
To mechanically clear scrub on affected parcels *[Desbrozar mecánicamente las parcelas matorralizadas]*	—										
Adequacy (%) *[Adecuación (%)]*	71	67	67	62	52	48	43	29	19	0	0

(1) See Appendix 2 for measures' codes explanation. *[(1) Ver Apéndice 2 para una explicación de los códigos de las medidas.]*

(2) 1: Aragón; 2: La Rioja; 3: Murcia; 4: Madrid; 5: Castilla-León; 6: Navarra: 7: Andalucía; 8: Cataluña: 9: Castilla-La Mancha; 10: Extremadura.

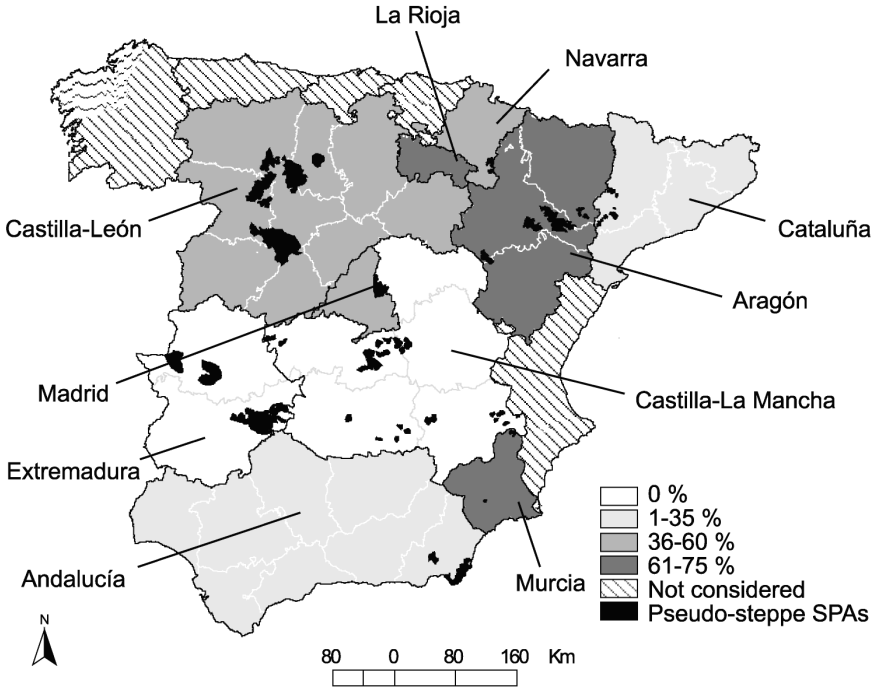

FIG. 1.—Adequacy of Spanish regional agri-environmental schemes to pseudo-steppe birds' conservation requirements, based on results presented in Table 1. SPAs (Birds Special Protection Areas) cartography following MMA (2004).
[Adecuación de las medidas agroambientales regionales españolas a los requerimientos de conservación de las aves esteparias, sobre la base de los resultados presentados en la Tabla 1. Cartografía de ZEPAs (Zonas de Especial Protección para las Aves) a partir de MMA (2004).]

the relative importance of distinctive habitat features changes in space or time (i.e. Suarez *et al*., 1999), the extrapolation of locally determined habitat-selection for a given species to wider scales could be questionable. Further, not all pseudo-steppe birds show the same habitat selection (Suárez, 2004) and therefore the relative importance of each desirable practice might be different for each species. However, the desirable practices, always proposed in qualitative terms, are referred to habitat features which are general enough as to be relevant for a majority of species, and basically coincide with the most important threats to agricultural habitats for birds in Europe (Tucker & Evans, 1997). Under the objective of transferring scientific knowledge on birds' biology to the assessment of policy design and potential effects we think that our approach is robust enough.

It could be argued that most of the assessed schemes did not formulate objectives linked to biodiversity conservation and, therefore, that our assessment underestimates the potential conservation value of the Spanish agri-environment programme. Would this analysis have been limited to just those four schemes aiming at biodiversity conservation (see Appendix 2), the adequacy of the programme towards pseudo-steppe birds' conservation would have been even lower (38% at the National level, 18% at the regional level). In spite of not formulating objectives explicitly linked to biodiversity conservation, the remaining schemes were included in the analysis as long as any of the included commitments was in line with any of the proposed desirable practices for pseudo-steppe birds' conservation.

This qualitative approach does not consider the (different) relative importance that each de-

sirable practice might have for pseudo-steppe birds' conservation, since all were treated as equally important. Obviously, this is not necessarily the case, as impacts of different magnitude on birds could be expected from each particular practice. However, since such impacts could also vary even for a single practice depending on the distinctive habitat features in each implementation area, for the shake of simplicity we have not considered these details. It is interesting, nevertheless, to note that there are certain practices that are most frequently prescribed by the regions, such as «maintenance of uncultivated field borders», «maintenance of stubble», «not to apply phytosanitaries on stubble and fallow land» or «not to harvest during night». On the other hand, there are six desirable practices that are never prescribed (see Table 1).

Also transcendent in terms of habitat heterogeneity is the limited combination of commitments prescribed in the schemes' design. Only 6 out of the 15 desirable practices included as commitments are prescribed together in the best case (Table 1, scheme 1.1). Given that the simultaneous adoption of different schemes by farmers is on a voluntary basis, this means, for instance, that a farmer signing an agreement under scheme 1.2 (*Systems' extensification for the protection of flora and fauna*) may plough up fallows and pastures without restrictions, is not obliged to introduce leguminous crop in the rotation, has no limits on inputs use, and may harvest at night (see Table 1). Therefore, it seems obvious that the stated conservation objective is not fully reflected in the schemes' design, because it lacks sound research at a regional research, which is essential in view of the effectiveness of this type of schemes (Caballero, 2001), or because there is insufficient political will.

Thirdly, the «horizontal» approach adopted in the new agri-environmental programme contradicts that of the previous one, which included «zoned» measures targeting specific areas (National Parks, SPAs, RAMSAR wetlands, and others defined by the regions; Oñate *et al*., 1998). This questionable soft focussed approach seems to aim at reaching as many farmers as possible probably in view of farm income protection, but with a disregard for biodiversity-related production functions of agriculture in each farm or area. Only a couple of regions have targeted schemes' implementation at areas where efficiency in regard to biodiversity conservation can be reasonably expected to be higher, such as SPAs. In a context of budget limitation, this zoned approach is deemed as much more appropriate, and in this sense, future zoned schemes could be better tailored to priority species and their distinctive habitat selection features in each area.

Behind the detected schemes' scarce adequacy to pseudo-steppe birds' conservation at the regional level is a clear implementation deficit of the agri-environmental programme. Out of the 10 considered regions, only 3 score over 60% adequacy, with Aragón as the most remarkable case (67%), which hold important SPAs for these communities (Fig. 1). Six regions attain intermediate scores (30% to 60%), including Castilla-León (58%) and Navarra (43%), both of which are also highlighted in terms of their pseudo-steppe habitats. Poorest scores (0% to 29%) appear in 4 regions, including Castilla-La Mancha and Extremadura without any single appropriate scheme implemented in their pseudo-steppe SPAs.

This implementation deficit could have far reaching effects, beyond neglecting pseudo-steppe bird conservation at present; it is seriously impeding a learning-from-doing process in the agri-environment policy arena, a domain definitely integrated in the Common Agricultural Policy since its last reform (Regulation EC/1782/2003). Receipt by farmers of the newly introduced *single farm payment* will be conditional upon the farmers' respect of cross-compliance requirements, including those stemming from Birds and Habitats Directives among others. In this immediate context, future agri-environmental schemes should be designed to go beyond this non-rewarded base-line level of environmental protection in farming, with narrower, deeper and more focussed commitments in the benefit of environment. The poor Spanish past experience on agri-environmental issues at all levels (institutions, farmers and their associations, scientific community; Peco *at al*., 2000) may impose serious burdens in the consistent planning of cross-compliance and future agri-environment schemes.

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APPENDIX 1 *[Apéndice 1]*

List of regional legislative acts implementing schemes under the agri-environmental programme 2000-2006 as in December 2003 (BO: Regional Official Gazette; n: number; p: page).
[Lista de actos legislativos promulgados por las administraciones regionales en desarrollo de medidas del programa agroambiental 2000-2006, hasta diciembre de 2003 (BO: Boletín Oficial de la Región; n: número; p: página).]

Andalucía: Orden 09/08/2002, BO 31/8/2002 2002, n. 102, p. 17237.

Aragón: Orden 07/01/2003, BO 15/1/2003, n. 5, p. 1329; Orden 19/03/2001, BO 23/3/ 2001, n. 35, p. 2070.

Castilla-León: Orden 02/12/2002, BO 10/12/2002, n. 237, p. 16392; Orden 26/12/2001, BO 28/12/ 2001, n. 251, p. 2.

Cataluña: Orden 01/03/2001, BO 12/3/2001, n. 3345, p. 3557.

La Rioja: Orden 13/02/2002, BO 16/2/2002, n. 21, p. 664; Rect., BO 14/3/ 2002, n. 32, p. 1145; Rect., BO 13/4/2002, n. 45, p. 1603; Rect., BO 3/9/2002, n 120, p. 4509.

Madrid: Orden 10/12/2001, BO 21/12/2001, n. 303, p. 41.

Murcia: Orden 14/01/2002, BO 24/1/2002, n. 20, p. 1120; Orden 08/01/2002, BO. 19/2/2002, n. 42, p. 2615; Orden 05/06/2001, BO 18/6/2001, n. 139, p. 9455; Orden 02/10/2001, BO 10/10/2001, n. 236, p. 13895; Orden 02/10/2001, BO 10/10/2001, n. 236, p. 13893.

Navarra: Orden Foral 02/10/2000, BO 23/10/2000, n. 128, p. 8624; Orden Foral 1526/2003, BO 11/11/2003, n. 149, p. 11294.

APPENDIX 2 *[Apéndice 2]*

List of agri-environmental schemes considered in the analysis according to codes (MAPA, 2000) presented in Table 1. Schemes aiming at biodiversity conservation are marked with an asterisk. The remaining schemes only formulate objectives linked to water, soil, and landscape preservation.
[Lista de medidas agroambientales consideradas en el análisis de acuerdo con los códigos (MAPA, 2000) presentados en la Tabla 1. Las medidas que persiguen objetivos de conservación de la biodiversidad se señalan con un asterisco. Las restantes sólo formulan objetivos ligados a la preservación de aguas, suelos y paisajes.]

1.1. Enhancement of traditional fallow: agri-environmental fallow
[Mejora del barbecho tradicional: el barbecho agroambiental]

1.1.2. Increase of traditional fallow index
[Incremento del índice de barbecho tradicional]

1.2. Extensification systems for the protection of flora and fauna*
[Sistemas de extensificación para la protección de la flora y de la fauna]*

1.2.1. Leguminous-sown fallow*
*[Barbecho semillado con leguminosas *]*

1.4.1. Production set-aside: dry land arable crops*
*[Retirada de tierras de la producción: herbáceos en secano *]*

3.1.1. Integrated control: dry land arable crops
[Control integrado: herbáceos en secano]

3.2.1. Integrated production: dry land arable crops
[Producción integrada: herbáceos en secano]

4.2. Fight against erosion: arable crops
[Lucha contra la erosión: herbáceos]

4.3. Maintenance of set-aside land
[Mantenimiento de tierras abandonadas]

5.3. Protection of flora and fauna in wetlands: cereal over-sowing*
*[Protección de flora y fauna en humedales: sobresiembra de cereal *]*

8.1. Landscape protection: Maintenance of singular-value elements
[Protección del paisaje: Mantenimiento de elementos de singular valor]

8.1.1. Landscape protection: Protection of non-productive woods
[Protección del paisaje: Protección de arbolado no productivo]

9.1.1. Actions in pastures and stubble
[Actuaciones en pastos y rastrojeras]