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MIGRATION AND CONSERVATION OF THE AQUATIC WARBLER *ACROCEPHALUS PALUDICOLA* IN SPAIN

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SUMMARY.—*Migration and conservation of the Aquatic Warbler* Acrocephalus paludicola *in Spain*. We have studied the migration routes and phenology of the Aquatic Warbler *Acrocephalus paludicola* throughout Spain by means of ringing and published observation data. The species' migration routes between breeding and winter quarters, both in spring and autumn, regularly take place through Spain. In the present study, two main coastal routes are described: the Atlantic and the Mediterranean. A third one, along the Ebro valley, seems to link the other two. Prenuptial passage, more easterly on average, takes place from early March to late April, though 87% of the records are from April. Postnuptial passage takes place from early August to late October, though 85% of the records are concentrated between 11 August and 29 September. In Spain, the species seems to use a low number of localities as stopover migration sites. We propose the adoption of effective protection measures for those areas that currently lack them. We also suggest the change of the species' conservation status in the National Endangered Species Catalogue.

Key words: *Acrocephalus paludicola*, Aquatic Warbler, conservation, migratory routes, phenology, Spain.

RESUMEN.—*Migración y conservación del Carricerín Cejudo* Acrocephalus paludicola *en España*. Las rutas migratorias y la fenología de paso del Carricerín Cejudo *Acrocephalus paludicola* por España han sido determinadas mediante datos de anillamiento y observaciones de campo publicadas. Esta especie transita regularmente por territorio español entre sus cuarteles de invernada en África y los lugares de nidificación, tanto en su migración prenupcial como en la postnupcial. En este estudio se describen dos grandes rutas migratorias litorales utilizadas por esta especie: una atlántica y otra mediterránea. Una tercera ruta parece unir las anteriores por el valle del Ebro. El paso prenupcial, en promedio más oriental, ocurre desde principios de marzo hasta finales de abril, aunque el 87% de los registros corresponden al mes de abril. El paso postnupcial tiene lugar desde principios de agosto hasta finales de octubre, aunque el 85% de los registros se concentran entre el 11 de agosto y el 29 de septiembre. La especie parece encontrarse en España en una serie relativamente reducida de localidades, que utilizan como lugares de reposo y alimentación a lo largo de su ruta migratoria. Se propone la declaración de medidas de protección efectivas para aquellas localidades que aún no cuentan con ellas. Además, se sugiere su cambio de categoría en el Catálogo Nacional de Especies Amenazadas.

Palabras clave: *Acrocephalus paludicola*, Carricerín Cejudo, conservación, España, fenología, rutas migratorias.

INTRODUCTION

The Aquatic Warbler *Acrocephalus paludicola* is a marshland specialist bird whose breeding range is restricted to the Western Palaearctic between 47° and 59°N, and east of 22°E. However, its easternmost distribution limits are not precisely known (Aquatic Warbler Conservation Team, 1999), and it still is the rarest migratory passerine in Europe, remaining globally threatened due mainly to habitat loss (Collar *et al.,* 1994; BirdLife International, 2000). Moreover, its wintering distribution is still poorly known, though central European birds are supposed to migrate in autumn to sub-saharan western Africa (Schulze-Hagen, 1989; De By, 1990).

The European populations of this species have suffered a dramatic decline (Tucker & Heath, 1994) and an international Action Plan for its conservation has been developed, in which one of the conservation priorities proposed is «to promote the protection of the species and its habitat [...] along the migratory route» (Heredia, 1996). Unfortunately, migratory routes are poorly known, especially in south-

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western Europe, though it is considered regular on passage in Spain as well as in other western European countries and Morocco (De By, 1990; Collar *et al.,* 1994; Tucker & Heath, 1994; Tellería *et al.,* 1999).

In Spain, the Aquatic Warbler is the only globally threatened passerine species (BirdLife International, 2000) and it is included in the «Insufficiently Known» IUCN category in the national Red Data Book (Blanco & González, 1992). In the present study, we aimed at achieving two main objectives: first, to define and characterise the species' migration routes and phenology in Spain; second, to analyse its current conservation status as well as that of the sites that it regularly occupies in our country.

Materials and Methods

Migration routes and phenology

For distribution and phenology purposes, we have tried to gather all the species' ringing data in Spain from 1965 to 1998, consulting the following data banks: Centro de Migración de Aves (SEO/BirdLife), ICONA (Dirección General de Conservación de la Naturaleza, Ministerio de Medio Ambiente) and Aranzadi. The distribution of Spanish ringers is far from homogeneous throughout the country (Cantos, 1992), and these regional differences in ringing effort could lead to erroneous conclusions about migration patterns obtained using these data. In order to test whether the observed pattern actually represents the bird's migration routes rather than the ringers' distribution, we have compared our data with the ringing effort spent in each province. As no ringing effort index is available at the data bank, we developed the following one: a total of 4343 ringing data were randomly selected from the ICONA data bank among those of small fledged passerines obtained between 1965 and 1998. For each ringing, we recorded the province and obtained an index of the number of birds ringed in each province during the time period considered in this study (except for Gipuzkoa, where rings used were from a different scheme —Aranzadi—).

In order to overcome the lack of ringing data in some provinces, we used any published observation record for the species until 1998 (references listed in Appendix 1). For the Canary Islands we have also used data from Martín & Lorenzo (in press). Up to 1998, no specific monitoring nor ringing programme had been developed in Spain (Jubete, 2001), so records used in our study are not biased towards the analysed species. In addition, to assess the regularity of the species' passage through the whole Iberian Peninsula, we also consulted data from 1976 to 1996 at the Portuguese ringing data bank (CEMPA/ICN-Central de Anilhagem, Ministério do Ambiente), that were assigned directly to some ringers and ringing stations.

The differences in the migration routes between sexes were not analysed, as Aquatic Warblers can only be confidently sexed during the breeding season (Dirk, 1993; Svensson, 1996). Concerning ageing, two age classes may be determined in autumn (Svensson, 1996): adults (birds fledged prior to the recording year) and first year birds (fledged on the year of recording). However, as detailed or in-hand observations are needed to confidently assign age classes (Svensson, 1996; Mullarney *et al*., 1999), and because this information has only been readily available for Spanish ringers and birdwatchers since the late eighties or even more recently, we have considered unreliable the use of the variable «age» in our study.

All recorded birds (ringed or observed) have been considered for every analysis performed as independent records. In assessing differences between spring and autumn passages, we have used Chi-square and Mann Whitney U tests (Siegel, 1956; Sokal & Rohlf, 1981). We have also used the Chi-square test for evaluating differences between bird captures and ringing effort.

Stopover sites protection

The protection status of the Aquatic Warbler stopover sites in Spain has been assessed by mapping all records and overlapping them, first with the SPA network (Special Protection Areas designated according to Directive 79/409/ CEE) and, second, with the IBA network (International Important Bird Areas proposed by SEO/BirdLife; Viada, 1998). We have used the designated SPAs list provided by the Ministerio de Medio Ambiente, updated to October 2000.

RESULTS AND DISCUSSION

Until 1998, a total of 148 Aquatic Warblers have been ringed in Spain with «Museo de Ciencias», «ICONA» and «Aranzadi» rings (Riofrío, 1998; Cantos & Gómez-Manzaneque, 1999; own data). Of these, we have only been able to collect data from 141 birds (34 for the spring period and 107 for autumn). Besides, published observations added 95 more records,

TABLE 1

Number of Aquatic Warbler *Acrocephalus paludicola* ringings in Spain and Portugal, as well as observation records for Spain. Observations prior to 1965 (n = 3) and records with no year mentioned (n = 3) have not been included.
[Número de anillamientos de Carricerín Cejudo Acrocephalus paludicola *en España y Portugal y de las observaciones en España. En la tabla no se han incluido las observaciones anteriores a 1965 (*n = *3) ni las citas en las que no figurase el año de observación (*n = *3).]*

Year [*Año*]	Ringed birds [*Aves anilladas*]		Observed birds [*Aves observadas*]
	Spain [*España*]	Portugal [*Portugal*]	Spain [*España*]
1965	7	—	
1966		—	
1967	1	—	1
1968	1	—	1
1969	1	—	
1970	4	—	
1971	11	—	
1972		—	
1973	3	—	
1974		—	1
1975		—	
1976			
1977		16	
1978		3	
1979	1	5	3
1980	3		2
1981	4	2	7
1982	1		5
1983	5		1
1984	7		2
1985	12	3	3
1986	5	3	1
1987	9	2	
1988	8	2	6
1989	6	2	1
1990	2	3	3
1991	1	1	2
1992	8	2	3
1993	13		13
1994	6	2	10
1995	9	4	9
1996	10	1	12
1997	1	—	1
1998	2	—	1
Total	141	51	88

26 of which were from spring and 67 from autumn (two winter records have not been taken into account due to their low reliability).

The number of records and its annual distribution support the idea of a regular passage of the species through Iberia (Table 1). In fact, despite the low numbers recorded each year (compared to other countries like The Netherlands, Belgium or France), that could be explained by a lower ringing and/or birdwatching effort during the bird's migration period (see, *e.g.* De By, 1990; Grandío, 1998), the whole west European population of the species is likely to cross the Iberian Peninsula in its migration (De By, 1990; Aquatic Warbler Conservation Team, 1999).

Migration routes

According to our data, the Aquatic Warbler seems to follow mainly coastal routes through Spain, both in the autumn and in the spring migrations (see Figs. 1 and 2). In the former, two main migratory flows can be established: a western one along the Cantabrian and Atlantic coasts (n = 74 records), and an eastern flow along the Mediterranean coast (n = 108 records). However, data from Aragon suggest a noticeable flow of birds through the Ebro Valley that could link both migration routes (n = 41 records), as proposed for the Sand Martin *Riparia riparia* and the Yellow Wagtail *Motacilla flava* (Mead & Harrison, 1979; Asensio *et al.,* 1991; Pérez-Tris & Asensio, 1997). The bird has also been recorded inland elsewhere, though the scarcity of records suggests that only a small proportion of birds actually migrate across inland Iberia following a broad front (n = 12 records). Data from the Canary Islands indicate that part of the birds follow the western coast of northern Africa on their way to the wintering grounds.

In order to verify that the observed pattern does not depend on the distribution of ringing effort in Spain, we compared the number of captures made in coastal and Ebro valley provinces (n = 111 birds) with the rest (n = 11

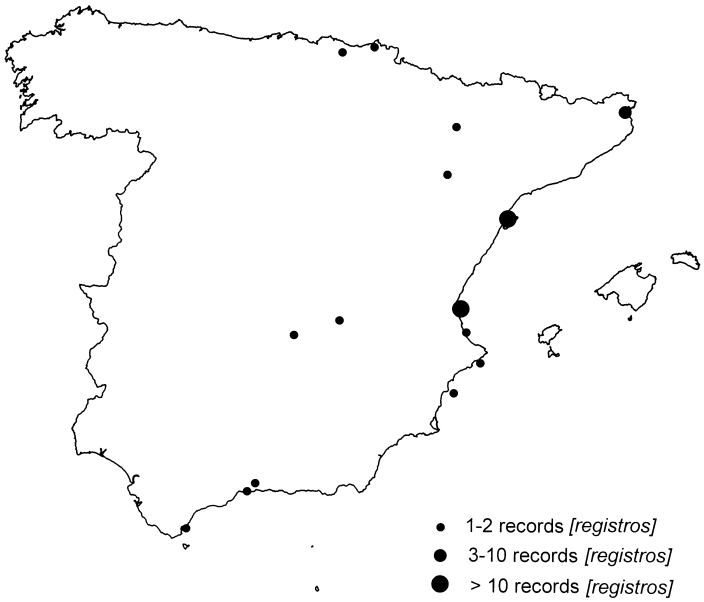

FIG. 1.—Distribution of the Aquatic Warbler *Acrocephalus plaudicola* records in Spain during the spring migration (1965-1998). Due to scale restrictions, Canary Islands (two records) are not represented in the map. [*Distribución de los registros de Carricerín Cejudo* Acrocephalus paludicola *en España durante la migración primaveral (1965-1998). Debido a restricciones de escala, las islas Canarias (con dos registros) no se representan en el mapa.]*

FIG. 2.—Distribution of the Aquatic Warbler *Acrocephalus plaudicola* records in Spain during the autumn migration (1965-1998). Due to scale restrictions, Canary Islands (two records) are not represented in the map. [*Distribución de los registros de Carricerín Cejudo* Acrocephalus paludicola *en España durante la migración otoñal (1965-1998). Debido a restricciones de escala, las islas Canarias (con dos registros) no se representan en el mapa.]*

birds), establishing as the null hypothesis that the number of ringings in both groups do not differ from those expected from the ringing effort (75.9 and 43.1, respectively). The number of ringings in coastal and Ebro valley provinces was larger than that expected according to ringing effort ($\chi^2_1 = 44.9$; $P < 0.001$). This pattern is even strengthened when the published observations were taken into account.

Spring data distribution among the three routes differred significantly from that in autumn ($\chi^2_2 = 69.340$; $P < 0.001$). Moreover, in the spring migration Aquatic Warblers followed a more eastern route (comparison of the geographic longitude of the records between both passage periods; $U = 3165.5$; $n = 235$; $P < 0.001$). Spring passage, thus, takes place mainly along the Mediterranean coast, though some individuals may also migrate inland through the Ebro Valley (Fig. 1). Spring data in the Canaries, however, indicate that this westernmost route in the pre-nuptial migration is not completely avoided by the birds to reach the breeding grounds.

These results also support the idea of the loop migration, according to which birds return to their breeding grounds more directly (Cramp, 1992) following a faster and more eastern route (Mester, 1967; Cruon *et al*., 1987; De By, 1990). This strategy has also been reported for other Sylvids and in other families of passerines (Da Prato & Da Prato, 1983; Bueno, 1991, 1992; Cantos, 1998), probably being a common pattern for transaharian birds in their migration through Iberia (Bernis, 1963).

Phenology

The intensity of migration also seems to vary between both periods, the post-nuptial passage spreading over a wider period than the pre-nuptial. In Figure 3 it is shown that, while the former appears mainly concentrated in one month (up to almost 87% of the records are from April), the latter is spreaded over more than two months (around 85% of the birds have been recorded between 11 August and 29

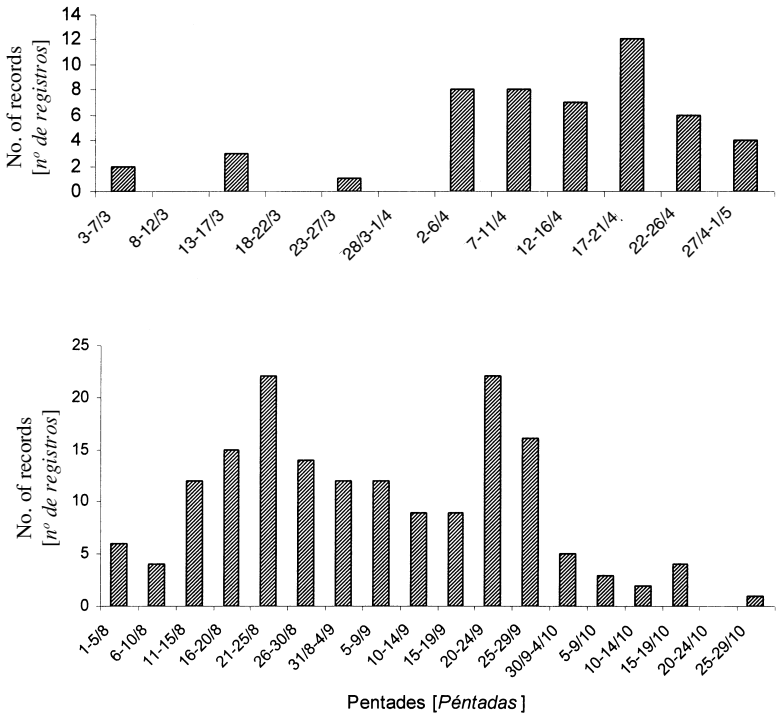

FIG. 3.—Aquatic Warbler *Acrocephalus paludicola* phenology between 1965 and 1998 in Spain based on ringing and observational data.
[Fenología del Carricerín Cejudo Acrocephalus paludicola *entre 1965 y 1998 en España, basada en datos de anillamiento y observaciones.]*

September), as has also been noted for other species (see, *e.g.* Mead & Harrison, 1979). Besides, this figure also suggests a bimodal distribution of the records for the autumn passage that seems to be consistent with the migration strategy proposed by Wawrzyniak & Sohns (see De By, 1990). According to this theory, adult males, first-brood juveniles and some adult females would migrate early in the season and second-brood juveniles and the remaining adult females later on.

In order to assess the speed of migration across Spain during both passage periods, we have performed two correlations of date against latitude. Spring migration is shown to be faster (Fig. 4). Competition among adult birds for arriving earlier to the breeding grounds in order to get a better territory could explain these differences (see, *e.g.* Potti & Montalvo, 1991; Aebischer *et al.*, 1996).

Stopover sites and conservation measures

Aquatic Warblers are habitat specialists that, during migration, make use of traditional stopover sites, and there is a relatively high concentration of records in some places and scarcity elsewhere (Cramp, 1992; Aquatic Warbler Conservation Team, 1999). Our data agreed with this migration pattern, that has important implications for the species conservation in Spain (Heredia, 1996; Aquatic Warbler Conservation Team, 1999). It has been recorded in 57 localities (Appendix 2), though most records are concentrated in a relatively short list: 14 places with at least four sights or ringings accumulate *c.* 78% of the records (Table 2). In these places, habitat consists mainly on stands of sedge and reed, as well as irrigated cropfields (basically rice), being similar to those described for the migration

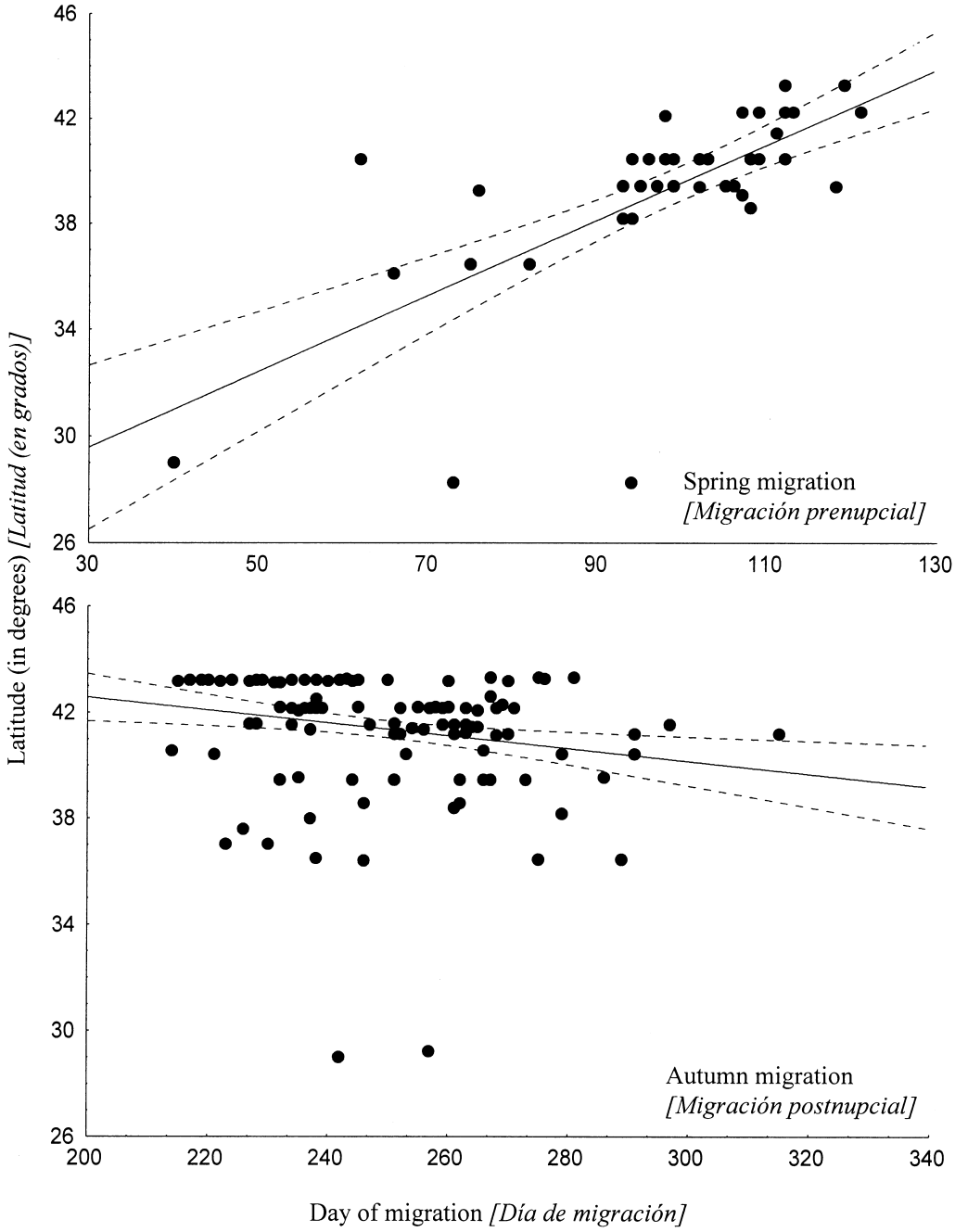

FIG. 4.—Relationship between day of migration of Aquatic Warbler *Acrocephalus paludicola* in Spain and latitude (in degrees). Date of migration is displayed according to Julian Calendar (1 Jan = 1; 31 Dec = 365). *[Relación entre el día de migración del Carricerín Cejudo* Acrocephalus paludicola *en España y la latitud (en grados). El día de migración se representa según el calendario Juliano (1 Ene = 1; 31 Dic = 365).]*

TABLE 2

Main stopover sites for the Aquatic Warbler *Acrocephalus paludicola* in Spain and their protection status. Provinces: SS, Gipuzkoa; BI, Bizkaia; PO, Pontevedra, C, Coruña; LU, Lugo; SE, Sevilla; H, Huelva; GI, Girona; B, Barcelona; T, Tarragona; CS, Castellón; V, Valencia; Z, Zaragoza; TE, Teruel; LE, León. * This place includes localities 5, 6, 11, 37, 49 and 51 listed in Apendix 2.
[Principales localidades de reposo del Carricerín Cejudo Acrocephalus paludicola *en España y estatus de protección del paraje. Provincias: SS, Gipuzkoa; BI, Bizkaia; PO, Pontevedra, C, Coruña; LU, Lugo; SE, Sevilla; H, Huelva; GI, Girona; B, Barcelona; T, Tarragona; CS, Castellón; V, Valencia; Z, Zaragoza; TE, Teruel; LE, León. * Galachos del Ebro incluye las localidades 5, 6, 11, 37, 49 y 51 del Apéndice 2.]*

Route *[Ruta]*	Place (Province) *[Localidad (provincia)]*	Coordinates *[Coordenadas]*	No. of records *[n.º registros]*	IBA *[IBA]*	SPA *[ZEPA]*	Migration *[Migración]*
Atlantic	Txingudi (SS)	43°22′N 1°47′W	29	Yes	Yes	Both *[Ambas]*
[Atlántica]	Ría de Gernika (BI)	43°19′N 2°40′W	4	Yes	Yes	Autumn *[Otoño]*
	Xunqueira do Lagares (PO)	42°15′N 8°44′W	8	No	No	Autumn *[Otoño]*
	Embalse de Cecebre (C)	43°18′N 8°21′W	5	No	No	Autumn *[Otoño]*
	Lagoa de Cospeito (LU)	43°12′N 7°34′W	5	No	No	Autumn *[Otoño]*
	Doñana (SE, H)	37°00′N 6°18′W	4	Yes	Yes	Autumn *[Otoño]*
Mediterranean	Aiguamolls de l′Empordà (GI)	42°18′N 3°09′E	27	Yes	Yes	Both *[Ambas]*
[Mediterránea]	Delta del Llobregat (B)	41°20′N 2°05′E	9	Yes	Yes	Autumn *[Otoño]*
	Delta de l′Ebre (T)	40°43′N 0°34′E	15	Yes	Yes	Both *[Ambas]*
	Marjal de Almenara (CS, V)	39°46′N 0°12′W	8	Yes	No	Both *[Ambas]*
	Marjal del Moro (V)	39°40′N 0°17′W	29	Yes	Yes	Both *[Ambas]*
Ebro valley	Gallocanta (Z, TE)	40°58′N 0°30′W	4	Yes	Yes	Autumn *[Otoño]*
[Valle del Ebro]	Galachos del Ebro (Z)*	41°36′N 0°90′W	33	Yes	Yes	Both *[Ambas]*
Inland *[Interior]*	Villadangos (LE)	42°30′N 5°51′W	4	No	No	Autumn *[Otoño]*

stopovers throughout the rest of Europe (De By, 1990; Nankinov, 1992). Ensuring the protection of these areas might be crucial for the preservation of the species. So far, fortunately, most of the main stopover sites have been identified and included in the IBA network (Table 2), though for most of them the Aquatic Warbler is not included in the species list of the area. From our point of view, criteria should be revised in these IBAs in order to include all species of conservation importance, as should also be in those areas not declared as IBAs. Moreover, all identified areas that hold birds passage (Appendix 2) should be regularly monitored, and IBAs listed in Table 2 should readily be declared as SPAs. For example, it has not been until recently that the Laguna de La Nava (Palencia) has been identified as especially important for the species (Jubete, 2001). Fortunately, this locality is already included in the IBA network and was also declared as SPA.

The Aquatic Warbler is the only passerine in Continental Europe which is classified as globally threatened ('Vulnerable'; BirdLife International, 2000) and at the European level it is classified as 'Endangered' (Tucker & Heath, 1994; BirdLife International/EBCC, 2000). Nevertheless, the species is included in Spain in the lowest category of the National Catalogue of Endangered Species ('Special Concern'; BOE, 1990), and none of the Spanish Autonomous Communities that indude a regular passage of the bird and have their own catalogue (Aragon, Asturies and the Basque Country) take the species into account. Since, according to our results, an important part of the European population seems to cross Spain in its migration, we suggest that the species should be catalogued as 'Endangered' in the National and Regional Catalogues as it is considered for the rest of Europe nowadays.

Finally, as countries with more than 100 records were considered in the preparation of the species' Action Plan, here we present data that support the need for considering Spain as one of the countries in order to cover their whole migratory flyway (Heredia, 1996).

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APPENDIX 1

Sources of observation data not included in the Bibliography.
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APPENDIX 2

Places in which the Aquatic Warbler *Acrocephalus paludicola* was observed and/or ringed in Spain between 1965 and 1998.
[Localidades en las que se han observado o anillado en España Carricerines Cejudos Acrocephalus paludicola *entre 1965 y 1998.]*

[1] Adra (36°45′N 3°01′W), 1 bird [*ave*]. [2] Aiguamolls (42°18′N 3°09′W), 27 birds. [3] Albufera del Grao (38°59′N 0°10′W), 1 bird. [4] Alegranza (29°24′N 13°32′W), 2 birds. [5] Alfajarín (41°37′N 0°42′W), 6 birds, [6] Alfranca (41°38′N 0°45′W), 2 birds. [7] Alhaurín de la Torre (36°4′N 4°34′W), 1 bird. [8] Almenara (39°46′N 0°12′W), 8 birds. [9] Bárcena de Cicero (43°25′N 3°3′W), 1 bird. [10] Cañas (42°31′N 2°22′W), 1 bird; [11] Casetas (41°43′N 1°01′W), 7 birds. [12] Delta del Ebro (40°43′N 0°38′W), 15 birds. [13] Delta del Llobregat (41°2′N 2°05′W), 9 birds. [14] El Hondo (38°16′N 0°41′W), 3 birds. [15] El Tarajal (36°43′N 4°25′W), 1 bird. [16] Embalse de Cecebre (43°18′N 8°21′W), 5 birds. [17] Embalse de Ullivarri-Gamboa (42°59′N 2°38′W), 1 bird. [18] Fuerteventura (28°25′N 14°00′W), 2 birds. [19] Gallocanta (40°58′N 1°3′W), 4 birds. [20] Gándaras de Budiño (42°1′N 8°38′W), 1 bird. [21] Gernika (43°19′N 2°4′W), 4 birds. [22] Gondomar (42°07′N 8°45′W), 1 bird. [23] Laguna de Cospeito (43°12′N 7°34′W), 5 birds. [24] Laguna de Fuente de Piedra (37°6′N 4°45′W), 1 bird. [25] La Laguna de Baeza (38°00′N 3°28′W), 1 bird. [26] Lagares (42°15′N 8°44′W), 8 birds. [27] Lanzarote (29°00′N 13°38′W), 2 birds. [28] Laukaritz-Mungía (43°21′N 2°51′W), 1 bird. [29] Lertutxe (43°13′N 2°44′W), 1 bird. [30] Loreto (42°08′N 0°25′W), 2 birds; [31] Marismas del Río Palmones (36°08′N 5°27′W), 1 bird. [32] Manjavacas (39°25′N 2°56′W), 1 bird. [33] Marisma Victoria-Noja (43°28′N 3°31′W), 1 bird. [34] Marjal de Xeresa Xeraco (39°05′N 0°15′W), 1 bird. [35] Marjal del Moro (39°4′N 0°17′W), 29 birds. [36] Millars (39°54′N 0°05′W), 2 birds. [37] Nuez (41°35′N 0°4′W), 2 birds. [38] Pantano de Grajera (41°22′N 3°37′W), 2 birds. [39] Parque Nacional de Doñana (37°16′N 6°31′W), 4 birds. [40] Punta Entinas (36°51′N 2°56′W), 1 bird. [41] Raos (43°28′N 3°48′W), 1 bird. [42] Rauvel-Call de Terres (40°43′N 0°42′W), 1 bird. [43] Río Algar-Altea (38°37′N 0°03′W), 1 bird. [44] Río Guadalhorce, 2 birds. [45] Salburua (42°51′N 2°4′W), 1 bird. [46] Salcidos-A Guarda (41°54′N 8°53′W), 1 bird. [47] Sebes-Flix (41°14′N 0°32′W), 1 bird. [48] Son Bou (39°56′N 4°08′W), 1 bird. [49] Pina (41°29′N 0°33′W), 1 bird. [50] Tablas de Daimiel (39°03′N 3°42′W), 1 bird. [51] Tauste (41°55′N 1°15′W), 14 birds; [52] Traba (43°13′N 9°00′W), 1 bird. [53] Txingudi (43°21′N 1°47′W), 29 birds. [54] Urgell (1°48′N 0°48′W), 1 bird. [55] Villadangos (42°3′N 5°51′W), 4 birds. [56] Villanueva de la Serena (38°58′N 5°48′W), 2 birds. [57] Villaviciosa (43°29′N 5°26′W), 3 birds.