

Preliminary results on the patterns of abundance and habitat use by Lapwing *Vanellus vanellus* and Golden Plover *Pluvialis apricaria* wintering in South Portugal

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Leitão, D. 1999. Preliminary results on the patterns of abundance and habitat use by Lapwing *Vanellus vanellus* and Golden Plover *Pluvialis apricaria* wintering in South Portugal. *Wader Study Group Bull.* 89: 60–65.

We selected four study areas in order to sample as wide a range of soil types and farming systems as possible. Between 1 November 1997 and 15 February 1998 we made 36 Lapwing and Golden Plover counts in the four study areas. We carefully recorded the number of birds, the species composition, and the activity of all flocks sighted in each land unit on both sides of a road which acted as a transect. The Lapwing was common in all study areas, while the Golden Plover occurred commonly only in one. The Lapwing and the Golden Plover were on average more abundant in December than in the other months. The pattern of habitat use by the Lapwing differed between study area, even between those with similar farming systems. Stubble was the most used habitat by Lapwing in Azambuja and Lezíria Sul, both as feeding and as roosting grounds. Pastures were the most used habitats in Odemira and Castro Verde, mainly for feeding. The Golden Plover's pattern of habitat use was very similar to Lapwing's in Castro Verde, where both species were abundant.

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INTRODUCTION

Several species of European waders (and charadriiforms in general) are dependent on farmland in at least part of their life cycle. This group includes the Lapwing *Vanellus vanellus* and the Golden Plover *Pluvialis apricaria*. The former is a widespread breeder on farmland of Central and Northern Europe, the latter is a high Arctic and upland breeder in northern Europe (Cramp & Simmons 1983, Hagemeyer & Blair 1997, Byrkjedal & Thompson 1998). Both species are totally dependent on central and southern European grasslands and farmlands during the winter period (Imboden 1974, Cramp & Simmons 1983, Byrkjedal & Thompson 1998). A proportion of these birds come from declining breeding populations elsewhere in Europe (see Marchant *et al.* 1990, Asensio 1992, Hagemeyer & Blair 1997). Although well-studied in northern Europe, especially in the UK, the wintering biology of these two species is still relatively unknown in more southern countries.

This study aimed to find out 1) the patterns of variation in the number of Lapwings and Golden Plovers wintering in south Portugal, 2) how these birds use the farmland habitats, and 3) what are the main factors affecting these patterns.

STUDY AREA

We selected four study areas in order to sample as wide a range of soil types and farming systems as possible (Figure 1). Each study area was a line transect, at least 9 km long, formed by several land units/fields either side of a country road. Table 1 summarises the main soil, climate and land use characteristics of these areas.

Lezíria Sul and Azambuja are located in the alluvial plain of the low Tejo River. The soils are alkaline, silty and clayish, and very rich in organic matter. The abundance of water associated with these soil characteristics permits intensive spring-irrigated farming of crops such as rice, tomato, corn and sunflower. This is most evident in Azambuja, while in Lezíria Sul, due to the higher salinity of the soil, most of the area is still used for cattle pasture and silage (Table 1). The other two areas are located 150 km south, in the Alentejo region. The soil is much more acid, stony and sandy, and in spite of being poor overall in organic matter, it contains scattered pools of high organic matter content (Cardoso 1965). In Castro Verde, due to the inland arid conditions, the habitat comprises typical Iberian dry grassland, dominated by autumn-sown cereal and extensive pastures. The Castro Verde transect had far fewer land units than the other three transects (Table 1). This is because the low productivity of the soil means that only the large land units are profitable, and



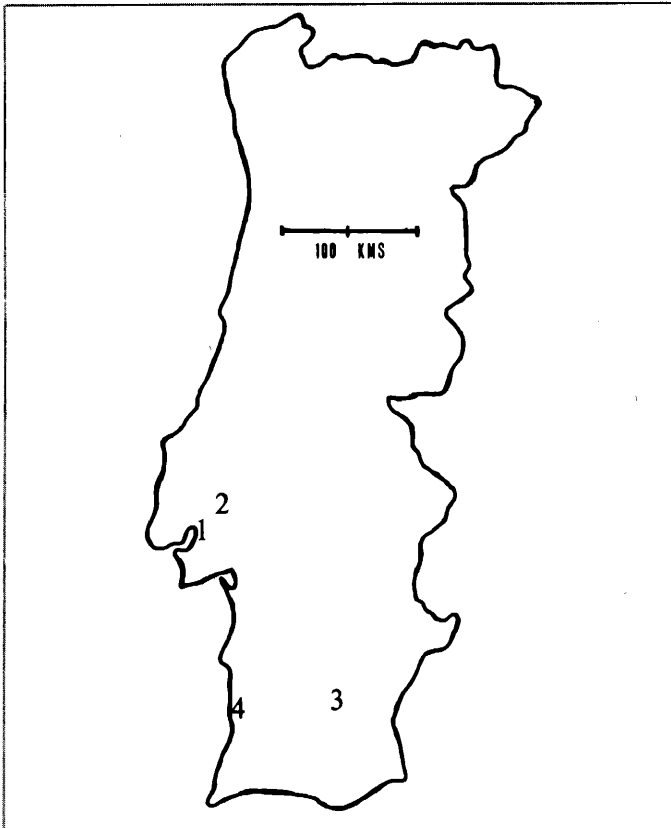


Figure 1. Location of the study areas in Portugal: 1– Lezíria Sul, 2– Azambuja, 3– Castro Verde, 4– Odemira.

consequently the landscape tends to be less patchy. In Odemira, on the other hand, with its humid coastal climate, the farming system is very similar to that of Lezíria Sul (Table 1).

METHODS

Between 1 November 1997 and 15 February 1998 we made 36 Lapwing and Golden Plover counts in the four study areas (transects in Table 1): 14 counts in Lezíria Sul, 11 counts in Azambuja, 6 counts in Castro Verde, and 5 counts in Odemira. The counts were made any time between from 0800 and 1600 hours. Birds were counted from a car. We drove at a maximum speed of 30 km/h, and stopped at each land unit to scan for birds. We did not make any counts in days with heavy rain or strong wind. When scanning we carefully recorded the number of birds, the species composition, and the activity of all flocks sighted in the land units on both sides of the road. Birds up to approximately 400 m distant were counted, except when the field width was less than 400 m (Table 1).

We recorded the flock activity as follows:

- * Feeding – when at least 50% of birds in a flock were searching for or handling prey;
- * Roosting – when more than 50% of birds were roosting;
- * Flying – when more than 50% of birds took flight for a reason unrelated to the presence of the observer;
- * Unknown – when more than 50% of birds were flushed by the observer without a previous assessment of their activity.

For a full description of these behaviours, refer to Barnard & Thompson (1985).

RESULTS

Bird abundance

During the 1997/98 winter Lapwing were more widespread than Golden Plover. As we can see in Table 2, the former species was common in all study areas, while the Golden Plover occurred commonly only in Castro Verde.

Lapwing were on average more abundant in December than in the other months. This pattern was observed in all study areas but Odemira, where it showed a higher abundance in January (Table 2). During the December/January period the Lapwing monthly average abundance varied between 31.6 and 60.8 birds/km, in Castro Verde and Azambuja, where it was more abundant, and varied between 14.5 and 28.3 birds/km in Lezíria Sul and Odemira, where it was less abundant (Table 2).

In Castro Verde, Golden Plovers were also more abundant in December. The December and January monthly average abundance of this species was even higher than Lapwing's (Table 2). In the other study areas the Golden Plover was scarcely recorded throughout the winter.

Habitat use

In Odemira and Lezíria Sul, in spite of the farming system similarities (see Table 1), the patterns of habitat use by the Lapwing were different (Table 3). The main difference was in the use of stubble fields. This habitat was the most used by Lapwing in Lezíria Sul, both as feeding and as roosting grounds (Table 3). In this area, pasture with cattle was the second most used feeding habitat, while winter fallow was the second most used roosting habitat. Both winter fallow and cereal/silage habitats were less used as feeding habitat. Stubble, along with pasture with cattle, were the only two habitats in Lezíria Sul with 100% of land units where at least one flock was recorded (Table 3). On the other hand, in Odemira the stubble fields were one of the less used habitats (Table 3). In Odemira the pasture with cattle was the most used by Lapwings for feeding and also for roosting, being followed by cereal only as feeding ground. Pasture with sheep had only one flock recorded (Table 3). In Azambuja the only habitats available are ploughed and unploughed stubbles. Lapwing used both, but used the unploughed stubbles more (Table 3). In Castro Verde the Lapwing seems to use all habitats with same intensity. Flocks were recorded in all land units, and only a slightly preference for feeding in pasture with sheep and for roosting in cereal was recorded (Table 3).

In Castro Verde, the pattern of habitat use by Golden Plover was very similar to Lapwing. The preferences for feeding in pasture with sheep and for roosting in cereal were more



Table 1. Study areas: transect, soil characteristics of the tilled layer (Cardoso 1965), climate (in Leitão 1993, Leitão & Moreira 1995, PNSACV 1995) and land use.

Study areas	Lezíria Sul (38°53'N, 8°58'W)	Azambuja (39°3'N, 8°49'W)	Castro Verde (37°41'N, 7°56'W)	Odemira (37°36'N, 8°46'W)
TRANSECT				
Size	10 km	9 km	10,5 km	14 km
Number of land units	34	31	18	46
unit width less than 400 m	10	16	3	35
unit width more than 400 m	14	15	15	11
SOIL				
Predominant soil type	Limestone alluvion	Limestone alluvion	Brown Mediterranean	Sandy or schistous podsol
Granulometry				
% stones (>2mm)	0	0	18-38.5	0-45
<2mm - % coarse sand	1.0	1-4.6	20.5-44	25.5-57
% fine sand	7.7	7.7-37.6	21-38	15-46.7
% silt	21.3	21.3-33.1	11-36	6-18.6
% clay	70	24.7-70	6-25	7-12
pH	7.6-8.6	7.8-8.6	5.8-6.2	5.0-6.7
% organic matter	2.49-2.76	1.52-2.49	0.3-3.7	0.91-2.58
CLIMATE				
Annual precipitation	645 mm		470 mm	600-700 mm
Av.Temp.Coldest Month	11.5° C		9.1° C	11° C
LAND USE				
Habitats ploughed in the autumn of 1997 (% of all land units)	Silage (35.3)	Ploughed stubbles and cabbage (41.9)	Autumn cereal (27.8)	Silage and Autumn cereal (17.4)
Habitats ploughed in the spring of 1997 (% of all land units)	Rice and corn stubble (20.6)	Tomato, corn and sunflower stubble (54.8)	----- (0)	Rice and corn stubble (23.9)
Habitats ploughed in 1996 or before (% of all land units)	Cattle pasture and winter fallow (44.1)	Sheep pasture (3.3)	Sheep and cattle pasture (72.2)	Cattle and sheep pasture (58.7)

obvious in Golden Plover than in Lapwing (see Table 3). This species seems to be more selective than Lapwing using the Castro Verde farmland, occurring in a smaller percentage of the studied land units (Table 3).

DISCUSSION

The phenological pattern of the Lapwing and the Golden Plover observed in South Portugal can be roughly described as follows: the birds started to arrive in late October and early November, were most abundant in December, and had departed by mid February (see Table 2).

In Lapwing, this pattern is consistent with a pattern observed in 1991/92 in the same area of Lezíria Sul (Leitão 1995). On the other hand, it is only roughly consistent with a pattern found for the whole Iberian Peninsula (Asensio 1992).

Asensio clearly highlights January as being the month when Lapwing were more abundant in three different areas of the Iberian Peninsula. However that pattern was based on ringed bird recoveries, and these depend mainly on hunted birds (Asensio 1992). It is possible that the higher volume of Lapwing recoveries found in January represents hunting pressure, instead of the real abundance of the species. However, it is also possible that Asensio's pattern represents the real average for the Iberian Peninsula, and the pattern found in this and the study carried out in 1991/92 is local or temporally specific. It has been reported by several authors that the yearly variation in the timing of migration and in the number of birds present in a certain period depends mainly on severity of the weather (Imboden 1974, Balança 1984, Kirby & Lack 1993). For example, Balança (1984) in northern France found a phenological pattern consistent with what we should expect for central Europe (see Imboden 1974) i.e. a



Table 2. Monthly abundance (mean birds/km \pm standard error) of Lapwing and Golden Plover in each study area on 1997/98. n = number of counts performed.

		November	December	January	February (until 15)
Lezíria Sul	Lapwing	17.2 \pm 5.3	28.3 \pm 10.1	14.5 \pm 7.8	10.1 \pm 10.1
	Golden Plover	0.2 \pm 0.2	2.0 \pm 1.3	1.8 \pm 1.8	1.9 \pm 1.9
	n	3	5	4	2
Azambuja	Lapwing	20.6 \pm 8.2	60.8 \pm 10.3	49.7 \pm 11.6	21.1 \pm 0.6
	Golden Plover	0 \pm 0	2.0 \pm 0.8	0 \pm 0	0.4 \pm 0.4
	n	2	4	3	2
Odemira	Lapwing	6.5 \pm 1.7	22.7 \pm 4.8	26.4	----
	Golden Plover	0.4 \pm 0.4	< 0.1	0	----
	n	2	2	1	0
Castro Verde	Lapwing	35.7	48.4 \pm 17.3	31.6 \pm 8.4	----
	Golden Plover	11.2	111.9 \pm 7.6	49.9 \pm 10.7	----
	n	1	2	3	0

Table 3. Habitat use by Lapwing and Golden Plover on each study area in 1997/98. Land units = number of land units containing a specific habitat; Flocks recorded = sum of flocks recorded on each habitat in all counts performed; Unit with flock = percentage of units of each habitat with at least one flock recorded; Feeding/unit = number of feeding flocks recorded per land unit (mean flock/unit \pm standard error); Roosting/unit = number of roosting flocks recorded per land unit (mean flock/unit \pm standard error).

		Lapwing					
habitat		Winter fallow	pasture with sheep	pasture with cattle	stubbles	ploughed stubbles	dry cereal and silage
Lezíria Sul	Land units	9	--	6	7	--	12
	Flocks recorded	16	--	15	35	--	7
	Unit with flock	78%	--	100%	100%	--	17%
	Feeding/unit	0.67 \pm 0.38	--	1.33 \pm 0.33	2.29 \pm 1.02	--	0.25 \pm 0.18
	Roosting/unit	0.67 \pm 0.29	--	0.33 \pm 0.33	1.43 \pm 0.67	--	0.33 \pm 0.33
	Azambuja	Land units	--	--	--	16	10
Flocks recorded		--	--	--	48	17	--
Unit with flock		--	--	--	75%	60%	--
Feeding/unit		--	--	--	0.94 \pm 0.25	0.5 \pm 0.27	--
Roosting/unit		--	--	--	1.06 \pm 0.5	0.8 \pm 0.36	--
Odemira		Land units	--	9	18	11	--
	Flocks recorded	--	1	24	4	--	4
	Unit with flock	--	11%	72%	18%	--	25%
	Feeding/unit	--	0.11 \pm 0.11	1.11 \pm 0.29	0.18 \pm 0.12	--	0.5 \pm 0.32
	Roosting/unit	--	0 \pm 0	0.22 \pm 0.17	0.18 \pm 0.18	--	0 \pm 0
	Castro Verde	Land units	--	7	5	--	--
Flocks recorded		--	33	18	--	--	24
Unit with flock		--	100%	100%	--	--	100%
Feeding/unit		--	3.71 \pm 0.64	3.4 \pm 0.81	--	--	3.4 \pm 0.31
Roosting/unit		--	0.71 \pm 0.42	0.2 \pm 0.2	--	--	1.2 \pm 0.49
		Golden Plover					
habitat		Winter fallow	pasture with sheep	pasture with cattle	stubbles	ploughed stubbles	dry cereal and silage
Castro Verde	Land units	--	7	5	--	--	5
	Flocks recorded	--	22	7	--	--	14
	Unit with flock	--	71%	40%	--	--	80%
	Feeding/unit	--	2.71 \pm 0.92	1.2 \pm 0.8	--	--	2.0 \pm 0.84
	Roosting/unit	--	0.14 \pm 0.14	0.2 \pm 0.2	--	--	0.8 \pm 0.37

peak in November, during autumn migration, and another peak in March, during spring migration. Although, in the cold January of 1980 no Lapwings were recorded in Balanço's study area, while in the mild January of 1981 more than 1500 birds were recorded.

For the Golden Plover the pattern observed in the present study was different from the Lezíria Sul in 1991/92, when the highest numbers were recorded in November, and the lowest in January and February (Leitão 1995). Nevertheless, both these patterns agreed with the overall European pattern of migration for the species (Byrkjedal & Thompson 1998): the main bulk of Golden Plovers should occur at the southern Iberian Peninsula only after 15 November, and all birds move north by mid February. It is also important to notice that the number of Golden Plover recorded in Lezíria Sul in the 1991/92 study (Leitão 1995) were much higher than the numbers recorded in the same place in the present study. Similarly to Lapwing, these differences in the abundance of Golden Plover might be related to climate conditions in central Europe. Golden Plovers leave the central European wintering areas during short periods of extreme frost, but return rapidly when the temperature rises (Fuller & Youngman 1979). Only a situation of long lasting frost in the Central European wintering areas forces the birds to spend longer in more southerly winter quarters (Fuller & Youngman 1979, Jukema & Hulscher 1988, Kirby & Lack 1993). Likewise, an unusually mild winter in central Europe could have been responsible for the overall low density of Golden Plover observed in the present study. However, the relationship between climate conditions in both Iberian and central European wintering areas and the abundance of Lapwing and Golden Plover in south Portugal needs more information to be fully understood.

Both Lapwing and Golden Plover are traditionally claimed to show strong preference for pastures during winter (Fuller & Youngman 1974, Cramp & Simmons 1983, Barnard & Thompson 1985, Byrkjedal & Thompson 1998, Scharenburg & Hoff 1998). It has also been stated many times that Lapwing are more flexible, and use a wider variety of farmland habitats, than Golden Plover (Balanço 1984,



O'Connor & Shrubbs 1986, Gregory 1987). The data presented here seems to agree with both aspects, at least for some of the study areas. Pastures were undoubtedly one of the most used habitats, except in Azambuja, where they don't exist, and the Golden Plover seemed to have used fewer land units than Lapwing in Castro Verde (see Table 3). Other studies performed in south Portugal, also showed similar results: in the Lezíria Sul the Lapwing used nine of the eleven habitats studied, while Golden Plover used only six (Leitão 1995). In the same study, and in others performed in the south-west coast (Beja *et al.* 1996), both species used the pastures more intensively than the crops or the stubbles. Moreover, during winter the Lapwing and the Golden Plover need to fulfill two different but equally important needs: to feed and to roost. Besides the use of pasture mainly as feeding habitat, Lapwing and Golden Plover, also used the stubble and cereal/silage fields both as feeding or as roosting places (see Table 3). The way (and the intensity with which) birds used the habitats varied considerably within the study area. This variation must depend in the first instance on the availability of each habitat category: in Azambuja the Lapwing used exclusively the stubble fields (to feed and to roost), because these were the only available habitats. However, even with rather similar farming systems, like Lezíria Sul and Odemira, there were marked differences in habitat use. These must be more related to habitat features and environmental factors relevant to the birds than with the land use (habitat type). Prey availability and distribution, field size, vegetation height and density, weather conditions, and moon-phase have been mentioned as being of great importance in Lapwing and Golden Plover's use of the habitat (see Fuller & Youngman 1974, Barnard & Thompson 1985, Gregory 1987, Shrubbs 1988, Milson *et al.* 1990, Kirby 1997, Byrkjedal & Thompson 1998). Only a complete assessment of the interactions between these factors will permit an understanding of the factors affecting Lapwing and Golden Plover habitat use in Portuguese farmlands.

ACKNOWLEDGEMENTS

Thanks to Cristina Mendes and Simon Gillings for their helpful comments and suggestions that dramatically improved the early versions of this manuscript. This work is being supported by Fundação para a Ciência e a Tecnologia (Grant Praxis XXI/BD/11137/97).

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