

Ornis Hungarica 12-13: 157-167. 2003

The census and distribution of wintering woodpigeons *Columba palumbus* in the Iberian peninsula

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Bea, A., Beitia, R. and Fernández, J. M. 2003. The census and distribution of wintering woodpigeons *Columba palumbus* in the Iberian peninsula. – Ornis Hung. 12-13: 157-167.



Throughout the 1997-1998, 1998-1999 and 1999-2000 seasons, Woodpigeon population censuses were carried out in their traditional Iberian wintering area, which comprises the south-western quadrant of the Peninsula. The method applied was the direct counting of flocks in communal roosts, of which 210 have been checked so far. Four counts were carried out per season in November, December, January and February. As an average, 95% of the roosts were counted simultaneously. Between 140 and 230 collaborators participated in each one of the censuses. These collaborators were mainly wardens from the Spanish autonomous regions and the Portuguese Government. Quantitative data suggests that the wintering population in the study area would total about 2.5-3 million birds, not including inter-yearly oscillations associated with reproductive success in the breeding areas. Their gregariousness remained relatively constant between November and January, 40-70% of the birds being counted in roosts of more than 400 000 individuals (1-2% of the number of roosts). Numbers were stable in this period, in spite of some inter-monthly differences attributed to difficulties in obtaining full cover. However, February offered a variable pattern. This phenomenon shows that dates of start of the spring migration must vary from year to year. The distribution of these contingents was not homogeneous within the study area, a massive presence occurring in Portugal and Extremadura-Toledo alternately. The evaluation of acorn production in Iberian *dehesas* and *montados* (pastureland) during 1999 provided interesting points for interpretation. For example, the low availability of food in cork tree woods during that winter explained the absence of birds in the Portuguese districts, and may have stimulated the start of migratory movements. The seemingly direct response shown by wintering Woodpigeons toward the nutritional capacity of the *dehesa* suggests that the analysis of this factor could allow predictions of the spatial and seasonal distribution of the population.

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1. Introduction

The Woodpigeon *Columba palumbus* is a member of the family Columbidae, a Palearctic, though mainly European, species. The subspecies *C.p. palumbus* breeds across the continent, from Russia

and Scandinavia to the Atlantic coasts and Mediterranean peninsulas (Saari 1997). Previously regarded as a woodland bird, its recent adaptation to, and trophic dependence upon cultivated fields has led to numerical prosperity in several European countries, allowing phenologic, behavioural and demographic changes to be

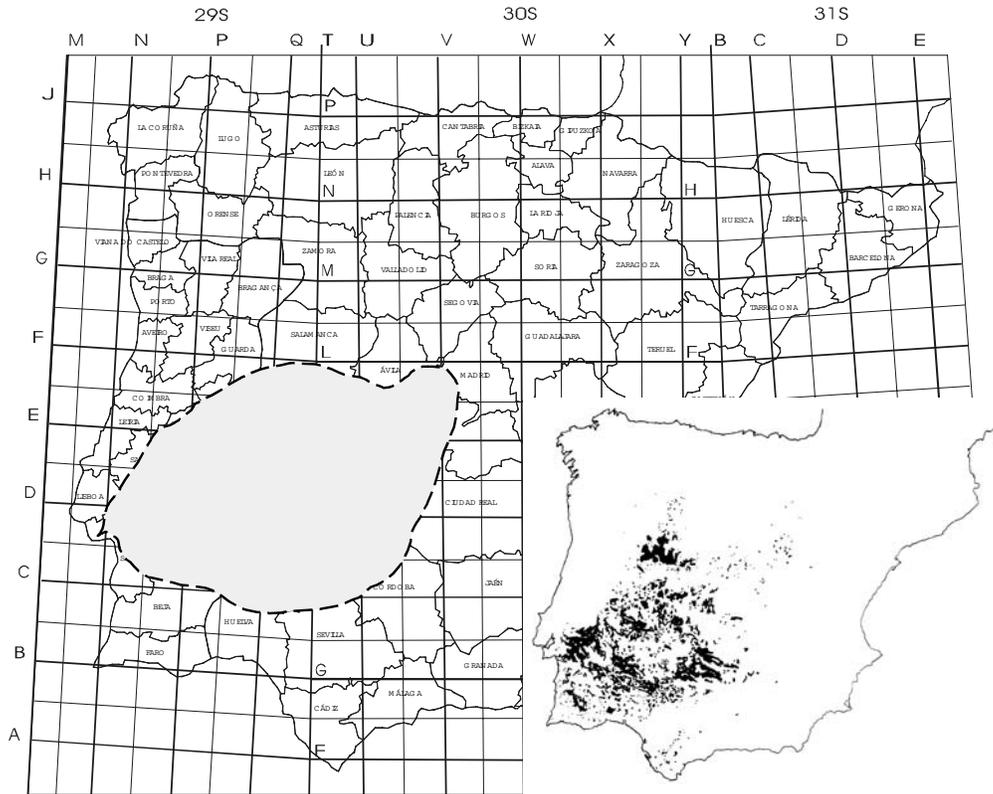


Fig. 1. The study area in the Iberian Peninsula and the range of dehesas and montados.

explained through shifts in agricultural techniques (O'Connor & Shrubbs 1986, Inglis *et al.* 1990).

Recognised migration patterns include partial or basically migratory populations, such as Fennoscandian and eastern European, as well as short-distance migratory and resident populations, as in Western Europe. This pattern has been described as a general alohiemism (Bernis 1966), because northern and eastern populations occupy winter quarters further south and west than intermediate populations. In this sense, the important role of the Iberian Peninsula as a wintering ground was first pointed out by Bernis (1967) and strengthened by Purroy (1988).

The Woodpigeon is a prominent game

species in many European regions as shown both by the total hunting bag across Europe, estimated at 9.5m birds yearly during the 1980s, (Purroy *et al.* 1984) and by such as social and cultural events related to the shooting season, for example Région Cynégétique du Sud-Ouest (1994).

Accurate population size information is a basic requirement for establishing a reliable monitoring program. Tracking this variable (and others such as reproductive success or survival rates) over periods of time will give early indication of population trends, whose appropriate interpretation may suggest managing or conservation measures. Thus, monitoring is a procedure to measure the history of variables in a systematic way, but with explicit aims

(Spellerberg 1991, Gilbert *et al.* 1998). The present study is a contribution to the quantitative knowledge and distribution of Woodpigeon population wintering in the Iberian Peninsula, and it also explores some of the applicable environmental factors.

2. Study Area and Methods

The study area approximates to the southwestern quadrant of the Iberian Peninsula and partially includes the Spanish regions of Castilla y León, Castilla-La Mancha, Madrid, Extremadura and Andalucía, and Portuguese Alentejo and Ribatejo (Fig. 1). The quadrant was defined after the analysis of the geographic distribution of recoveries during the winter months of December and January of birds ringed in many European countries, 88% of recoveries being entered in databases up to 1997 (N=58) of Spanish and Portuguese ringing schemes (Dirección General de Conservación de la Naturaleza, Instituto da Conservação da Natureza and Sociedad de Ciencias Aranzadi) were from inside the quadrant. Bernis (1967) had used the same method to define the wintering quarters of trans-Pyrenean migratory Woodpigeons.

The area of the quadrant corresponds largely to those regions whose landscape mostly comprises *dehesas* and *montados*. These habitat types are principally wooded pasturelands with holm oaks *Quercus ilex* and cork oaks *Quercus suber* in densities of 20-60 trees/ha, and have multifarious productive uses, cattle raising in holm oak woodland and cork exploitation in cork oak woodland being relatively important (Gómez 1997). The total extent of

these habitats in the Iberian Peninsula depends on the defining criteria, but c3.1m hectares is a reasonable estimate (Díaz *et al.* 1997).

Of course, other areas in Iberia hold wintering Woodpigeons, and these have also been studied. However, winter densities there are much lower than in spring and summer (Díaz *et al.* 1996), and it is possible that wintering birds belong to the more sedentary native Iberian populations. That some from these populations move towards the southwestern quadrant (Gallego 1985) would explain the density reductions. Lack of ringing effort applied to resident populations obscures knowledge about their migration patterns.

The method employed to undertake a census of wintering Woodpigeon populations in the study area was adapted from that used in France for the same purpose (Région Cynégétique du Sud-Ouest, 1994). The first phase, an inventory of roosting sites, was carried out in 1997, and was achieved through personal inquiries to administration officials, wardens, shooting federations, birdwatchers, naturalists, local people and others involved in wildlife management. A database was compiled of 'sites' mentioned by any informant. A 'site' was defined as any location noted ever to have been used as roosts by Woodpigeons. The database was constantly updated to delete 'sites' that had been felled or burnt down and to include newly discovered roosts. At the time of writing, the total set comprises 218 roosts (including former 'sites'), 118 of them being in Spain and 100 in Portugal.

It was not possible to use the data from inquiries to make rough estimates of population sizes and trends, because many observations were inaccurate and roosting

behaviour was not consistent at any particular site.

The population census method chosen was to count directly the birds gathered in known roosting sites, a technique applied generally to censuses of gregarious wintering birds such as herons, gulls and starlings, because it allows absolute numbers to be established by taking into account the contiguous distribution of birds and separating the counts into detectable recognisable units (Tellería 1986). An important requirement is for counts to be simultaneous, so that possible biases, due to bird mobility, dispersion or interchange between roosts, are avoided. Because of the high number of roosts to be visited, 140 to 230 observers (mainly official and wardens) collaborated in each census period, so that an average of 95% of counts were done simultaneously on the planned dates.

Censuses were performed in the winters of 1997-1998, 1998-1999 and 1999-2000. In each winter four census periods were established, in November, December, January and February (except 1997-98, when there was no February count). Dawn counts are preferable, because the movement to the feeding areas is direct and occurs in large flocks at sunrise and over a short timescale. Dusk counts occur over a longer period, but because the birds often use pre-roosting sites and are unsettled, the risk of double-counting is high. In any case, the census methodology included visiting the roosting sites the previous evening, when the arrival headings to roost usually were but one or two, the next morning's departure headings being the exact opposite. Knowing these routines helped the choice of the most favourable observation points. Observers made pru-

dent rough estimates of numbers at dusk in case the weather prevented proper counts the next morning.

Observers received training sessions to explain study goals, the species' natural history, census procedure and the methods to be employed to count large flocks (divide them into lesser units; Bibby *et al.* 1993). Great emphasis was placed on these sessions in order to stimulate responsible and effective participation and to reduce bias due to unsound counts. Good observer training is one of the factors that increases counting accuracy (Erwin 1982, Cantos & Tellería 1985).

As well as this net of collaborators, we formed a mobile team of experienced observers, its task being to detect and count bigger roosts whose size exceeded normal counting skills. Alternative techniques were used, such as counting different flocks of birds by different groups of observers, and taking advantage of boundaries as marking points while flocks passed them.

During the overall counting period, we began in 1999 an evaluation of acorn production in Iberian *dehesas* and *montados*. We selected at random 25 routes on secondary and country roads within the study area (18 in Spain and 7 in Portugal). In each, 25 sample points were selected, evaluating acorn production in a randomly-selected tree to produce a semi-quantitative index. The average acorn crop in each route or wood came from the expression:

$$P_i = \Sigma(N_p \times I_p) / 25$$

and

$$N_p = A_p / [(D_p / 100)^2 \times (\pi / 4)]$$

where P_i is the average crop in the

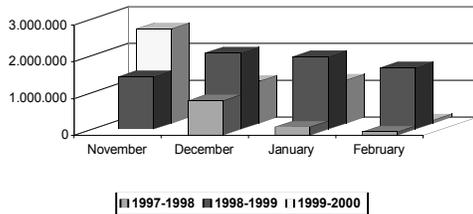


Fig. 2. Results of Woodpigeon censuses in 1997-1998, 1998-1999 and 1999-2000 winters.

route, N_p the equivalent number of trees in the 1ha plot throughout the sample point, I_p the semi-quantitative index of acorn production in the particular tree, D_p its diameter (cm), and A_p the basal area in the plot (m^2/ha).

This method, developed by Instituto de la Madera, el Corcho y el Carbón of the Junta de Extremadura, provides a simple and rapid sampling technique to be used in field conditions, and gives accurate measurements (C. Bernal *pers comm*). Samples were taken in the first fortnight of October, when fruit growth allows visibility from the ground, but the state of fruit maturity precludes it from being lost through falling.

3. Results

Fig. 2 shows the total numbers of Woodpigeons counted in November, December, January and February for the winters of 1997-1998, 1998-1999 and 1999-2000. The population size is assessed at 2.5 to 3 million birds (disregarding inter-annual fluctuations) It has been assumed that the number of birds using unknown or unvisited roosting sites, or sleeping in dispersed flocks are not significant, although these were not counted. The lower figures for 1997-98 are probably due to observer inexperience or to

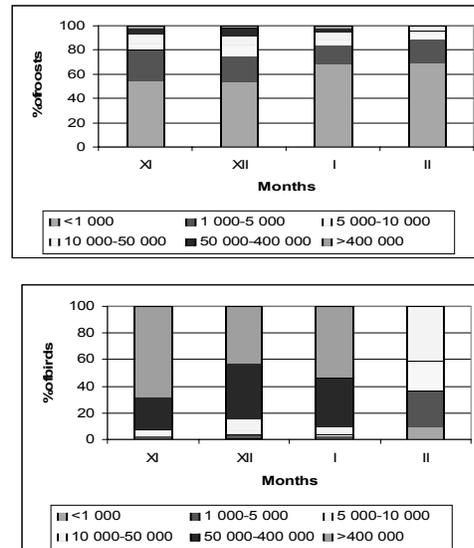


Fig. 3. Percentage of occupied roosts by roost-size category (above) and percentage of birds counted by roost-size category (below).

problems of achieving observer cover or proper coordination in the first winter, rather than to a lack of birds.

The cover achieved of roosting sites (sites planned to be visited/sites actually visited) averaged 88% in 1998-99, declining to 65% in 1999-2000. This reduction in achieved cover could also explain the decline in Woodpigeon numbers between November and December 1999, for it is difficult to attribute to factors other than census performance. The November cover of 70%, declined to 63% in December. Given the widespread gregarious distribution of the birds, the level of cover acts an indicator of counting effort, but not in a way proportional to the censused population, because only a few unvisited sites holding significantly large roosts would result in reductions to the overall totals counted.

Also relevant was the contrasting numerical stability during the winters of 1998-99 and 1999-2000 for the period of

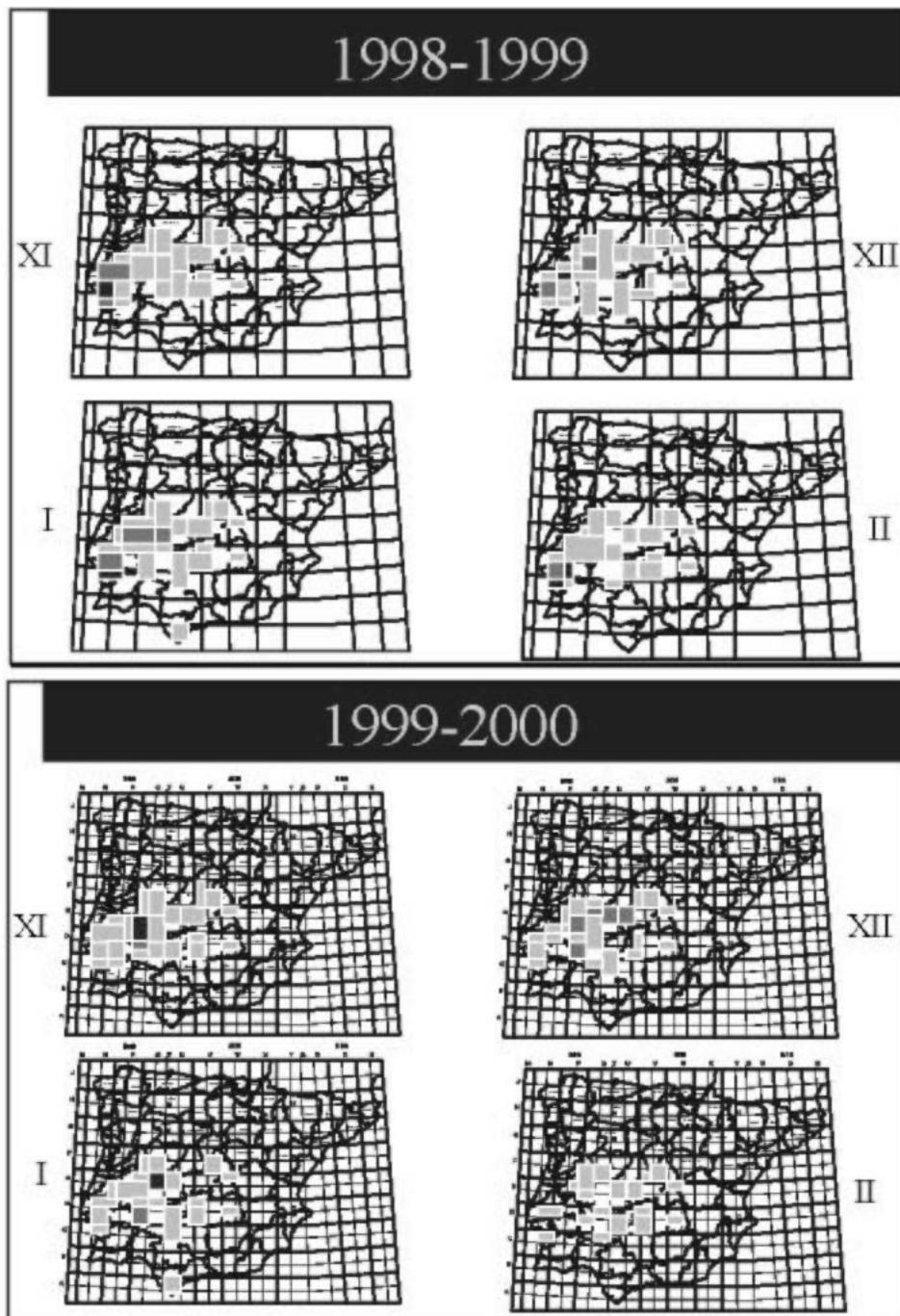


Fig. 4. Distribution of wintering Wood pigeons across the study area during November, December, January and February of 1998-1999 (above) and 1999-2000 (below). Light grey squares stand for fewer than 50 000 birds counted in that particular square; dark grey squares stand for between 50 000 to 500 000 birds; black squares stand for more than 500 000 birds.

January and February. In 1998-99, the numbers reduced by only 15.5%, but in 1999-2000, by 93.1%. This difference cannot be attributed to variations in counting cover, but reflected shifts in gregarious behaviour that either stimulated a reduction in roost size, or initiated early return migration. In the first case, the birds would not have been in the roosts to be counted because of short-range dispersal within the study area, and in the second, the birds would have left the study area entirely.

To describe the gregarious behaviour of Woodpigeons, the roost occupation and population held in winter 1999-2000 were categorized by roost-size (Fig. 3). About 80% of roosts each held fewer than 5000 Woodpigeons, but less than 10% held more than 50 000 birds each. Yet they held 80-90% of the censused population, demonstrating the intense gregariousness of the species. Large aggregations of course are more detectable than small, but it is unlikely that significant numbers of dispersed, smaller aggregations were missed. This pattern clearly was modified by February, as described above.

In Fig. 4, the distribution is shown of Woodpigeon numbers within the study area for 1998-1999. The most remarkable feature during the four count periods was that the bulk of the population remained in Portuguese coastal districts. Fig. 4 also shows that the distribution during the 1999-2000 winter (except for February 2000, as surmised above) was biased towards the interior regions, mainly in Spain

The average acorn crop estimated throughout all the selected routes in 1999 was 367.5kg/ha, a value considered as medium-low against accepted standard

ranges by Ceballos & Ruiz de la Torre (1971) and Montoya (1989). Nevertheless, clear variable patterns between cork oak and holm oak acorn production were found. Average crops in cork-oak dominated pasturelands 86.4kg/ha ($\sigma=43.8$, $N=5$), against 438.2kg/ha ($\sigma=233.4$, $N=20$) in holm-oak dominated pasturelands, the difference being highly significant ($t=3.3$, $P<0.01$). Furthermore, crop variability in cork oaks was low, with poor production everywhere (apparently synchronized), but results from holm oaks pasturelands showed greater dispersion. Also of interest was that the acorn crop in Spanish *dehesas* and Portuguese *montados* (independent of tree species) differed significantly (457.9 kg/ha against 136.1 kg/ha; $t=3.44$, $P<0.01$).

4. Discussion

Through evaluation of the acorn crop in Iberian *dehesas* and *montados*, the distribution of Woodpigeon population in the study area can be explained satisfactorily. Acorns from cork and holm oaks are a principle winter food for this population, as are dicotyledonous leaves at the beginning of the season (Purroy *et al.* 1984). However, cork and holm oaks show a complementary distribution in the Iberian Peninsula as a consequence of different ecological preferences. Cork oaks occupy sectors possessing mild oceanic climate, relatively high humidity and a low incidence of frost. Holm oaks are more resistant to cold and temperature contrasts, so that their basic distribution lies across sectors of continental climate (Gómez 1997). In this way, the abundance of cork oak pasturelands in the landscape increases

from NE to SW, being dominant in Portuguese districts, nearly exclusively so coastally. In the 1999-2000 winter, the study area lacked a cork oak crop, and so the Woodpigeon distribution shifted to regions where holm oak pasturelands were dominant, mainly in Spain. Crop levels measured in 1999 in *dehesas* and *montados* were confirmed by other independent evaluation schemes (C. Bernal *pers comm*, Vázquez *et al.* 2000).

This close fit between the spatial distribution of Woodpigeons and their *potential* trophic resources (a provisional hypothesis that will require data series from several years) is observed at wider, landscape scale. Locally, the actual food availability is influenced by some extremely variable factors (Borchert *et al.* 1989). Woodpigeon food shortages may arise from an abundance of seed predators, whether invertebrates (beetles and caterpillars, [Vázquez 1998]) or vertebrates (cattle, and to a lesser extent, rodents), and their level of intake, which in turn is related to the existence of alternative resources for the seed predators (Pulido 1999).

In man-made ecosystems such as *dehesas* and *montados*, management can determine the productivity of the trees, by external means (farming and forestry practices) and by exploitation of internal (genetic) variations (Koenig *et al.* 1991), thus determining fruit availability. For instance, the degree of shrub cover in *dehesas* was positively related to rodent abundance (Díaz *et al.* 1993). Moreover, shrub regeneration depends on grazing pressure and the economic orientation of each individual *dehesa* (San Miguel 1999).

In our samples, cork oak pasturelands showed greater basal area, tree density and

shrub cover than holm oak pastureland, although the differences were statistically significant only in the first and second parameters (t test, $P < 0,01$). These structural features could play a role at a detailed scale in the way Woodpigeons select feeding areas, but there are no real data on that topic. Basal area and tree density (closely and positively related; $r = 0,8$, $t = 6,2$, $P < 0,001$) influence production, and shrub cover would favour predation pressure on Woodpigeons and an abundance of seed-eating rodents.

As a whole, even though at a detailed scale the above-mentioned factors are responsible for great variability between plots, the close fit between the patterns of distribution of potential food resources and of the birds is circumstantial evidence that such resources are limiting environmental factors (Newton 1998). In Great Britain and Sweden, the effect of food availability on Woodpigeon densities in the post-breeding period repeatedly has been shown (Murton *et al.* 1964, Nilsson 1984, Inglis *et al.* 1990). In the Iberian Peninsula, crop variability in holm oak pasturelands would allow the maintenance of body fitness and weight in wintering birds (Purroy *et al.* 1984) in spite of the greater reproductive synchronism of cork oak pasturelands. Both types of habitat could be described as having almost complementary roles, which probably allowed the Iberian Woodpigeon winter population to evolve as a dynamically stable component of the species' migration strategy.

We think it would be unreliable for population trends to be drawn from population figures from the present direct census and from the previous estimates obtained since the early 1980s (5-6 million wintering birds [Purroy & Rodero 1986]),

because the respective methodologies were substantially different. Since 1981, direct, season-long counts of migrating flocks of Woodpigeons have been made at the Iraty pass in the French Pyrenees (Région Cynégétique du Sud-Ouest 1994). Trends show this migratory population to be declining slightly, for reasons that are unclear; there may be a real decrease, or the migration route may have changed.

Nevertheless, the range of the wintering population has probably reduced, because the presence of birds in southern *dehesas* was not verified in the 1997-2000 period, despite good food availability. Twenty years previously, the use of this area was evident, at least in some winter months (Purroy *et al.* 1984). Fidelity to winter ranges could play a role in the regular occupancy of Tajo-Sado basin, between the Toledo and Setúbal.

There is some evidence that the start of the return (spring) migration may change between years, for in February 2000 there were several observations and reports of flocks migrating through the central Spanish mountains. It would appear that these movements flout the hypothesis of dispersion of flocking birds, and as yet there is no explanation. Complex mechanisms, genetically fixed and of an hormonal nature, act to stimulate migratory behaviour in birds as *proximate* factors (Berthold 1993). We note that the modulating or synchronizing effects of some environmental conditions have been proved, especially for species that have a northerly breeding range, such as for Common Crane *Grus grus* (Alonso *et al.* 1990).

We suggest that food availability in the Woodpigeons Iberian wintering range influences the start of return migration.

The reproductive strategies of cork and holm oaks shows differing temporal patterns, the former having a sustained crop for a longer period through the winter months (Cañellas *et al.* 1991, Cañellas 1993). Consequently, we suggest that the holm oak pasturelands crop would be more likely to be consumed by seed predators, especially when production is medium or low, as has been observed in *Fagaceae* trees in temperate latitudes (Crawley 1992, Siscart *et al.* 1999) and particularly in *dehesas* of holm oaks (Pulido 1999) and cork oaks (Herrera 1995, Vázquez *et al.* 1997). Reproductive strategies and plant recruitment in these species is generally interpreted under the “satiation of consumers hypothesis” (Janzen, 1971), which is verifiable in highly-productive fruit seasons that exceed the consumption capacity of crop predators.

Finally, the described fit between Woodpigeon distribution and the species’ potential food resources, even with predicted capacity at meso-scale or regional scale (Newton, 1998), would relegate to secondary roles other factors sometimes claimed to explain so-called spatio-temporal “irregular” wintering. Such factors include shooting or the degree of protection afforded by roosting sites against meteorological conditions (Purroy *et al.* 1984), although these could have a local influence over habitat selection in relation to feeding or roosting areas.

Acknowledgements. Observers, without whom this study would never have been possible, were mainly officials and wardens from the regional Spanish administrations of Andalucía, Castilla y León, Castilla-La Mancha, Extremadura, Álava, Bizkaia and Gipuzkoa, from Patrimonio Nacional, from the Portuguese Government department Direcção

Geral das Florestas and from shooting federations in southwestern France. The regions of Aquitaine, Midi-Pyrénées and País Vasco also have to be thanked. Funds were provided by Fondo de Cooperación Euskadi-Aquitania, Union des Federations Departementales des Chasseurs and Federación Española de Caza.

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