

Population size of Montagu's harrier *Circus pygargus* in the Castro Verde SPA (Portugal)

Recenseamento da população da Águia-caçadeira *Circus pygargus* na ZPE de Castro Verde (Portugal)

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RESUMO

As populações da Águia-caçadeira *Circus pygargus* têm vindo a decrescer por toda a sua área de distribuição, incluindo em Portugal. A Zona de Proteção Especial (ZPE) de Castro Verde, no sul de Portugal, contém a maior população da espécie no país. Apesar do seu estatuto de conservação “Em Perigo” não existem censos recentes dirigidos para a espécie, tanto nacionais, como regionais. Em 2010 foi realizado o primeiro censo de Águia-caçadeira na área da ZPE de Castro Verde. Foram realizadas três campanhas de amostragem, percorrendo, em cada uma, 175 km de transectos lineares. A densidade da espécie foi determinada através da metodologia *Distance* e extrapolada para a totalidade da área da ZPE. Para determinar o número de casais reprodutores utilizou-se a densidade das fêmeas e dos machos. A população da Águia-caçadeira foi estimada em 486 indivíduos (intervalo de confiança de 95%: 307-760) e em 205 a 324 casais reprodutores (intervalo de confiança de 95%: 128-495). As metodologias utilizadas são adequadas para censar a espécie e constituem uma base adequada para a monitorização a longo prazo da espécie na ZPE.

Montagu's harrier *Circus pygargus* is a migrant breeder in Europe (Cramp 1998, García & Arroyo 1998). The Portuguese population is estimated in 500-1000 pairs (BirdLife International 2004), representing 13% of European population, excluding Russia, and is classified as Endangered by the national authorities due to a persistent population decline (Cabral *et al.* 2006).

Castro Verde Special Protected Area (SPA), located in Southern Portugal (08°14'W, 37°54' N - 07°46'W, 37°34' N), is the main cereal steppe area in the country (Costa *et al.* 2003), with 85 349 ha, 69% of which comprise pseudo-steppe habitat (Triosphere 2010). It has national and international importance for several steppe birds, including Montagu's harrier (Costa *et al.* 2003, Equipa Atlas 2008).

Few studies have focused on this species in the SPA and the accurate population size is unknown. During the 1990s, Montagu's harrier surveys in the core area of Castro Verde SPA (ca. 17 500 ha of Castro Verde and Mértola municipalities) showed a significant decline from 72 breeding pairs in 1994 to 43 pairs in 1999 (Fragoso *et al.* 2000, Franco *et al.* 1996). Although not aiming to census the species, recent studies also calculated the number of birds in

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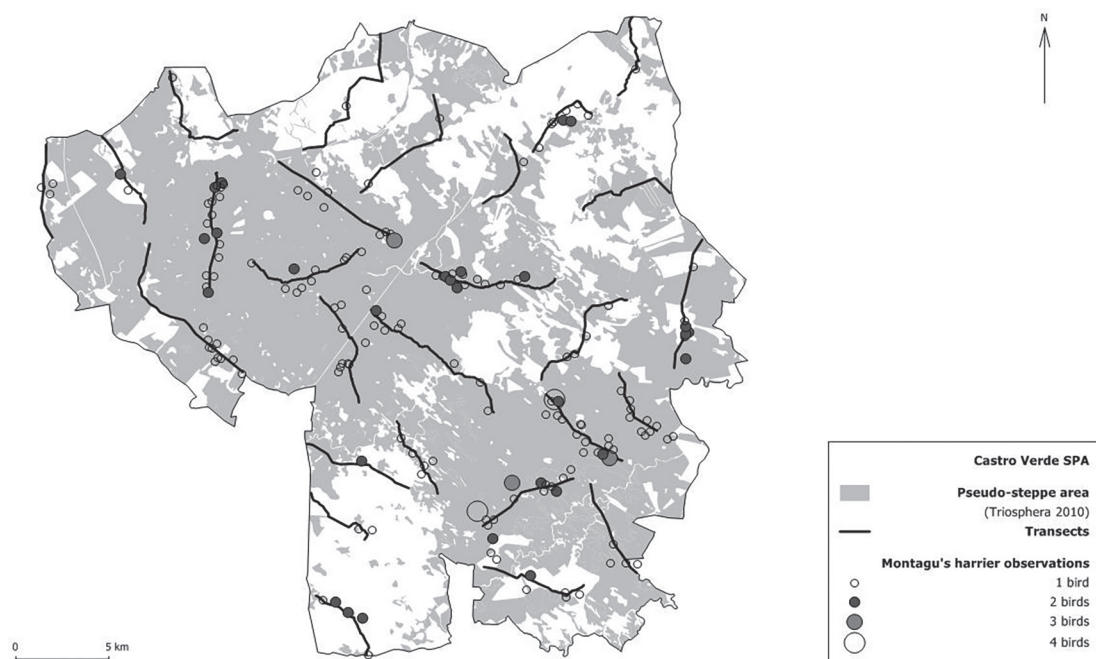


Figure 1. Transect location, pseudo-steppe area and distribution of Montagu's harrier sightings in 2010 in the Castro Verde SPA.

Figura 1. Representação dos transectos amostrados e das observações da Águia-caçadeira na ZPE de Castro Verde em 2010.

the SPA. Claro *et al.* (2006) estimated 70-100 breeding pairs in 2004, and Moreira *et al.* (2007) roughly estimated 1074 birds during the 2006 large-scale assessment of distribution patterns and breeding populations of steppe bird species in the region.

During 2010 we conducted the first Montagu's harrier census throughout the Castro Verde SPA. We repeated the 1990s field methodology based on car surveys but increased the number of transects and the covered area, sampling the entire SPA (Figure 1). We used a distance sampling approach, based on line-transect surveys (Bibby *et al.* 1992). A total of 27 linear transects, ranging from 4,3 to 10,0 km length (total of 175 km), were randomly defined along the SPA, separated by at least two kilometers to avoid double counting of individuals (Figure 1). Different habitats were surveyed, namely

pseudo-steppe, cork oak woodlands, olive plantations and bush areas. As the entire SPA was sampled and transects were randomly selected, the sampled habitats and their proportion were assumed to be representative of its occurrence.

Two observers conducted car surveys, at a speed of 10-20 km/h. Each observer was assigned to one side of the transect area. The location of each bird was mapped and its perpendicular distance from transect was determined in a GIS. Transects were considered spatial replicates and sampled once a month, from April to June 2010 (3 samples per transect in total).

Montagu's harrier density in the Castro Verde SPA was estimated with Conventional Distance Sampling in *Distance 6.0* software (Thomas *et al.* 2010). We used AIC (Akaike's Information Cri-

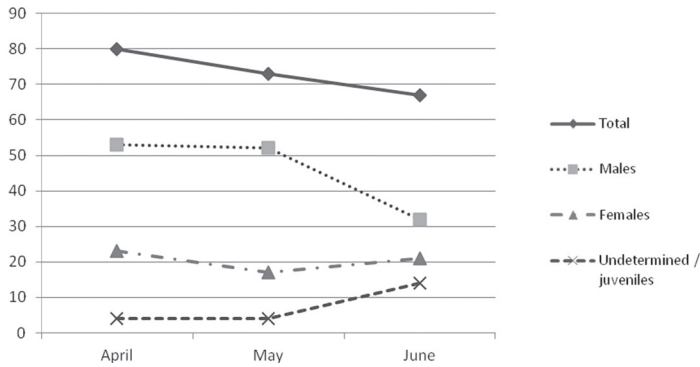


Figure 2. Number of Montagu's harriers sighted per month in the Castro Verde SPA in 2010.

Figura 2. Número de registos da Águia-caçadeira por mês de amostragem na ZPE de Castro Verde em 2010.

terion) for model selection (Buckland *et al.* 2001, Burnham & Anderson 2004). To produce more accurate estimates we followed Buckland *et al.* (2001) recommendations and truncated 5% of the data, removing potential outliers. Bird observations may not be independent since this species shows a colonial behavior during breeding season (Cramp & Simmons 1980, Onofre 1994). However, 81% of the observations corresponded to single birds (of-

ten hunting away from the breeding area), and high levels of bird aggregation (i.e., groups of 4 birds) were only detected in 2 occasions. To determine the species detection function we tested different models, assuming either observations as single individual and as clusters (that performs better with colonial behaviour; Thomas *et al.* 2010), and chose the model with better goodness of fit as the final model.

	Density (number of birds/ 100ha) [95% Confidence Interval]	Abundance in Castro Verde SPA (number of birds) [95% Confidence Interval]	Analysis (key model)	Sample size	Bird data	CV (%)
Total of birds	0,57 [0,36 – 0,89]	486 [307 – 760]	Hazard Rate	121	Clusters	22,6
Females	0,24 [0,15 – 0,38]	205 [128 – 324]	Negative Exponential	61	Individuals	24,1
Males	0,38 [0,25 – 0,58]	324 [213 – 495]	Hazard Rate	100	Individuals	20,7

Table 1. Summary of density estimates (number of birds/ 100ha) and abundance (number of birds) of the Montagu's harrier in Castro Verde SPA in 2010. CV: coefficient variation of the estimate; Bird data: observations were analyzed as *clusters* or as single birds.

Tabela 1. Resumo da estimativa de densidade (número de aves / 100ha) e abundância (número de indivíduos) da Águia-caçadeira, em 2010, na ZPE de Castro Verde. CV: coeficiente de variação da estimativa. Bird data: registos analisados enquanto *clusters* (grupos) ou aves isoladas.

Density value (number of birds per ha) was used to determine the size of the population within the SPA, regardless of the habitat. So, we extrapolated the density value to the total area of the SPA (85 349 ha).

Montagu's harrier was observed in 26 of the 27 sampled transects, showing a widespread distribution along the Castro Verde SPA. A total of 220 sightings were recorded during the survey period: 80 in April, 73 in May and 67 in July (Figure 2). Harriers were more frequently seen in continuous pseudo-steppe areas, but were also present at non steppe habitats if pseudo-steppe patches occurred (Figure 1). Eighty percent of all observations were in pseudo-steppe habitat (40,9% in fallow lands and pastures; 39,8% in cereal fields and 2% in plowed land); 9,9% in open cork oak woodlands and 7,2% in other habitats, as cork oak woodlands, olive plantations and streams.

We had a disproportional high number of male sightings (137) when compared with female numbers (61), most of them recorded in April and May (Figure 2). In July, harrier's detectability was lower due to high temperatures (possibly due to reduced bird activity or to lower detectability by the observers), and the first fledglings were observed. Due to these sights we decided to estimate the number of birds based on the results of males and females sampled during April and May, before the first juvenile's sightings.

Sex-ratio of Montagu's harrier in the studied area is unknown and may be skewed or vary between years (Arroyo 2002). Therefore, we estimated the maximum number of breeding couples based on male sightings in April and May and the minimum number of breeding couples based on all sightings of females.

We estimated a density of 0,57 birds per 100 ha and a population of 486 (95% CI: 307-760) Montagu's harriers in Castro Verde SPA (Table 1). The minimum number of breeding pairs was estimated at 205 pairs (95% CI: 128-324) and the maximum

at 324 pairs (95% CI: 213-495), when considering females and males, respectively (Table 1). The three estimates are within the same order of size. However, we suspect that (i) the minimum number may be underestimated due to the lower female detectability during the nesting period (females stay longer at the nest; Franco *et al.* 1996) and (ii) the maximum number may be overestimated since some males may not be breeding during that year (females may start to breed sooner in their life cycle than males, possibly in their first spring; Arroyo 1996, Cramp 1998).

It is difficult to compare our results with those from previous studies, due to differences in the sampled area or in the methodologies applied, which often relate to studies' aims. Claro *et al.* (2006) work focused on rescuing nestlings during the harvesting period and only followed some nests (51); and Moreira *et al.* (2007) used point counts to estimate the species density, which is inadequate to survey raptors as stated by the authors. Although Fragoso *et al.* (2000) and Franco *et al.* (1996) used a similar methodology in 1994 and 1999 census, only continuous, favorable pseudo-steppe area was monitored (20,5% of the SPA), which probably holds higher bird density than the remaining areas. Based on the 1999 and 1994 data, the extrapolation to the current pseudo-steppe area in the SPA (ca. 58 891 ha) results in a total of 145 or 242 pairs, respectively. The breeding population estimated in this study (205-324 pairs) is comparable to the breeding population of 1990s, however this comparison must be taken with caution, as the sampled area changed across the studies.

Our estimates suggest that Castro Verde SPA holds 40% to 65% of the Montagu's harrier national population (500-1000 couples; BirdLife International 2004), which highlights its importance for the species. This study also provides an adequate methodology for the species' long-term monitoring in the SPA that may act as a baseline for future surveys.

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