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SHORT COMMUNICATION

A quantification of illegal hunting of birds in Gipuzkoa (north of Spain)

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Abstract The illegal hunting of wild birds is still today a major threat to the conservation of biodiversity on a global scale. This activity jeopardizes the survival of several migratory species. Our aims in this work were to (1) determine the spatial and temporal distribution of illegal hunting activities affecting bird species with regard to the location of fixed hunting posts in particular, and (2) identify the most affected species in Gipuzkoa (north of Spain), situated in a bottleneck area within one of the main routes of migration between Europe and Africa. All of our data came from birds with firearm injuries that were admitted to the Gipuzkoa Wildlife Rehabilitation Center (WRC). Over a period of 8 years (2006–2013), 421 birds belonging to 53 species were registered. The number of shot birds was found to be greater in more highly populated areas and during the months coinciding with hunting periods. Moreover, shot birds were recovered close to fixed hunting posts, suggesting that the illegal shooting of birds took place near or directly from these posts. Although the figures were not comparable to the high numbers of migrants shot annually in some other southern European areas, our results show that, even in small areas like Gipuzkoa, increased levels of protection are necessary.

Keywords Bird migration · Gipuzkoa · Shooting · Raptors · Wildlife rehabilitation center

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Introduction

The illegal hunting of avian species still continues to pose a major threat to the conservation of biodiversity on a global scale. Although this activity is stated to be more prevalent in Africa or Asia (Alonso et al. 2005; Baker et al. 2004; Isfendiyaroglu et al. 2007; Magige et al. 2009; Qureshi et al. 2011; Randrianandrianina et al. 2010), it is also common in some northern regions, e.g., in Europe (Bego and Malltezi 2011; Kralj et al. 2012; Macedo-Sousa et al. 2012; Martín et al. 2007; Pinto et al. 2005; Thirgood and Redpath 2008).

The illegal hunting in Europe causes the deaths of millions of birds every year, including species subject to reintroduction programs or strict protection (Hernandez and Margalida 2009; Pinto et al. 2005; Smart et al. 2010). Such species include several raptors (Agostini and Logozzo 1997; Watson and Whitfield 2002), seabirds (Raine et al. 2013), passerines (Geny 2000; Murgui 2014), or grouse (Baskaya 2003; Rojas et al. 2011). Illegal hunting is also one of the most serious threats to the conservation of several migratory species especially in certain regions from southern Europe or northern Africa (Kralj et al. 2012; Smart et al. 2010; Zwarts et al. 2009).

The first study dealing with the geographic and temporal distribution of illegal hunting of birds in Europe and the circum-Mediterranean region was carried out in the 1990s (McCulloch et al. 1992). Southwestern European countries, such as Portugal, France, Spain, and Italy, have higher levels of poaching than countries in northern Europe, although illegal bird killing is also a serious problem in northern Europe (Smart et al. 2010; Whitfield et al. 2003). Mapping the spatial and temporal distribution of this activity and identifying the most affected bird species are crucial for determining the location of hot spots and assessing the degree of illegal hunting and subsequently for establishing efficient protection measures.

The province of Gipuzkoa is a region of ~1900 km^2 (~0.4 % of the total area of Spain). In spite of its relatively small size, this area is notable for having high bird abundances, especially during migration period (Galarza and Tellería 2003; Tellería et al. 2009). This is due to the particular geographic location of the region, which has the Pyrenees to the east and the Bay of Biscay to the north, hence constituting a bottleneck area of birds moving along the East Atlantic flyway (Berthold 2001; Newton 2008). As a result, shooting birds from fixed posts is a widespread hunting practice throughout the province and, unfortunately, illegal hunting (in particular illegal shooting) has not yet been eradicated. Dozens of birds with firearm injuries are found each year and many of them are taken to the regional Wildlife Rehabilitation Center (WRC), chiefly larger species (small passerine birds are under-represented in this sample).

Using data from the Gipuzkoa WRC, our aims in this work were to (1) determine the spatial and temporal distribution of illegal hunting activities affecting avian species, particularly in relation to the location of fixed hunting posts, and (2) identify the most affected species, already knowing that small passerine birds are under-represented in this sample. We only used data from birds with gunshot injuries for the study.

Methods

Gipuzkoa is a mountainous province situated in the Eurosiberian region. The population is just over 700,000 inhabitants, mostly concentrated in the main urban areas in the northeast of the province. Outside these populated areas, the landscape consists of a mosaic of rural farms, meadows, and forests (either exotic pine plantations or natural forests where the European beech *Fagus sylvatica* is the dominant tree).

Data on birds with firearm injuries were collected from the list of all the birds admitted to Gipuzkoa's WRC during the period 2006–2013. The WRC is located at the municipality of Donostia-S. Sebastián. The data provided for each individual were as follows: location (municipality) where the bird was found, species, date, and reason for admission (shot, others). Unfortunately, the WRC did not record sex and age categories.

The geographic distribution of the fixed hunting posts and the number of hunting permits issued each year were provided by the Gipuzkoa Administration. The number of inhabitants in each municipality was obtained from the 2012 census (source: Gipuzkoa Administration).

During the period 2006–2013, 421 birds with firearm injuries were registered at the WRC. Ten individuals (2.4 %) originated from regions other than Gipuzkoa (Bizkaia, 2; Navarra, 1; Rioja, 2; Soria, 2; Salamanca, 1; France, 2). These birds were removed from our data set. Of the 411 birds found to have been shot in Gipuzkoa, the specific municipality was identified in 365 birds (88.8 %). We thus only used these birds for the analysis of the geographic distribution.

We performed a general linear model with the number of birds found with a shot as an object linear variable and the number of inhabitants in each municipality and the number of fixed hunting posts at each municipality as covariates. All variables were standardized for the analysis.

We used Monte Carlo simulations to test whether birds with gunshot injuries were more likely to be found near fixed hunting posts than those birds admitted to the WRC for other reasons. First, we calculated the distance from the site where the bird was found (centroid of the municipality) to the nearest fixed hunting post. The mean distance of the birds (both shot birds and others) from the nearest fixed hunting post was re-sampled 1000 times, using Monte Carlo simulations with the tool PopTools for Excel (Hood 2011). The difference between these two means was then calculated and re-sampled 1000 times. When the mean difference (re-sampled) and its 95 % confidence interval (CI) exclude zero, it can be concluded that the difference is significant. We did not consider bird species found only along the coastline (seabirds) for this analysis, since their potential geographic distribution is biased and does not include the entire province. Overall, we obtained a sample size of 1707 birds (shot, 365; others, 1342).

To analyze whether the number of individuals with gunshot injuries varied seasonally, we conducted a generalized linear mixed model, with the number of shot birds as a response variable, the year as random factor, and the month as fixed factor. Due to the nature of the object variable (counts), we used a log-linear link function with Poisson errors.

Results

Between 2006 and 2013, the WRC in Gipuzkoa admitted 2593 birds, of which 421 (16.2 %) had been shot. We identified 53 species, of which only 13 (24.5 %) could be hunted legally. The group including hawks, eagles, and falcons (Falconiformes) was the most frequent taxon, accounting for 48.7 % of the number of shot birds. A 67.0 % of this proportion was due to only two species: the common buzzard (*Buteo buteo*; 42.5 %) and the Eurasian sparrowhawk (*Accipiter nisus*; 24.5 %). This was followed by the Charadriiformes (19.7 %). Each of the remaining orders comprised <10 % of the total abundance (Table 1).

At least one bird with gunshot injuries was received from 60 out of the municipalities existing in Gipuzkoa (68 %). The number of shot birds found per municipality ranged from 1 (16 municipalities) to 83 (Donostia; mean±SE, 6±2 birds).

We found a high concentration of shot birds in northeastern Gipuzkoa (Fig. 1). Three municipalities in this zone

Table 1 Number of birds with firearm injuries found in Gipuzkoa during the period 2006–2013

Order	Shot	Shot (%)	Hunting (%)	Shot outside legal periods (%)
Pelecaniformes	2	0.5	0.0	–
Ciconiiformes	21	5.1	0.0	–
Anseriformes	3	0.7	100.0	0.0
Falconiformes	200	48.7	0.0	–
Gruiformes	13	3.2	23.1	33.3
Charadriiformes	81	19.7	43.2	11.4
Columbiformes	38	9.2	57.9	9.1
Strigiformes	7	1.7	0.0	–
Caprimulgiformes	1	0.2	0.0	–
Coraciiformes	6	1.5	0.0	–
Piciformes	1	0.2	0.0	–
Passeriformes	38	9.2	57.9	13.6
Total	411	100	20.6	11.8

We also show the percentage of birds that belong to species whose hunting is allowed in Gipuzkoa and the percentage of the latter that were hunted outside permitted periods

(Donostia, Hernani, Irún) contributed 37.6 % of the total number of birds with firearm injuries found in Gipuzkoa.

The number of birds shot at each municipality was observed to be positively influenced by both the number of inhabitants (F=326.55, P<0.001) and the number of fixed hunting posts [F=6.03, P=0.017; B-parameters (±SE): number of inhabitants, +8.98±0.50; number of fixed hunting posts, +0.12±0.05].

According to the Monte Carlo simulations, the mean distance from the points (municipality centroid) where birds were found to the nearest hunting post was significantly greater for all the birds which arrived at the Gipuzkoa WRC (for any reason) than for the fraction of shot birds admitted (re-sampled difference, 245 m; 95 % CI 60–416 m; Fig. 2). Thus, shot birds were more likely to be found near fixed hunting posts.

The annual number of birds found with firearm injuries did not vary significantly along the study period (r=−0.064, P=0.881; minimum, 40 birds in 2006; maximum, 74 birds in 2010), but the number of licenses provided each year tended to decrease (r=−0.998, P<0.001; from 20,347 in 2006 to 17,263 in 2013). The number of shot birds found was not correlated with the number of licenses provided that particular year (r=0.036, P=0.932), and the ratio birds/licenses was not correlated with time (r=0.119, P=0.780).

The mean number of birds found with a firearm injury varied seasonally (F=25.717, P<0.001). This mean tended

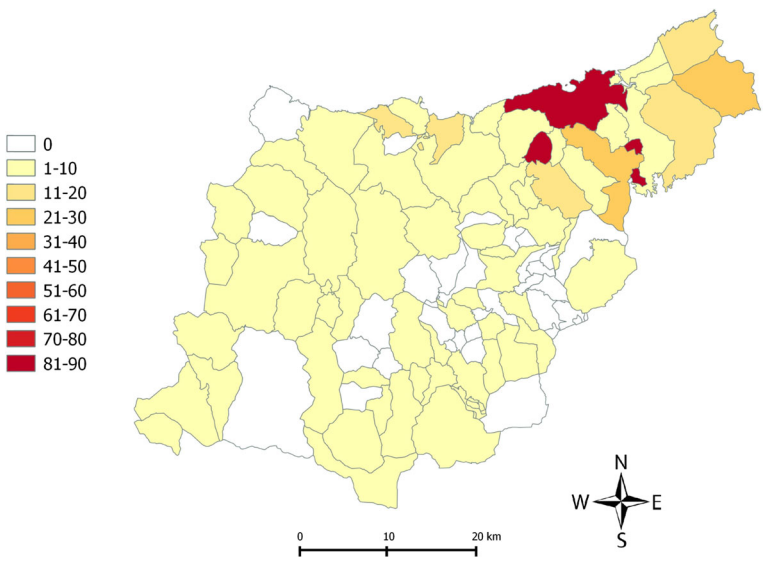

Fig. 1 The geographic distribution of the number of shot birds admitted to the Gipuzkoa WRC (period 2006–2013). The *polygons* are the municipalities of Gipuzkoa

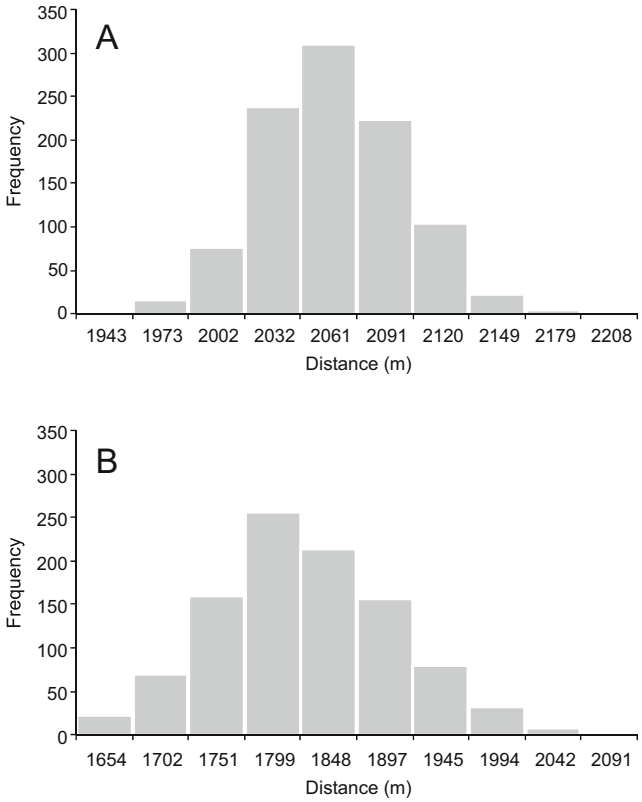

Fig. 2 Frequency distribution of the distance between the recovery site and the nearest hunting post for all birds admitted to the Gipuzkoa WRC (**a**), and only considering those admitted with firearm injuries (**b**)

to be less than 4 shot birds/month from February to September, reached a peak in October (with almost 14 shot birds/month), and subsequently decreased through to January (5 shot birds/month), when still we found a higher mean value than in subsequent months (Fig. 3).

Overall, 11.2 % of those birds whose hunting was allowed were shot outside the legal hunting period (Table 1).

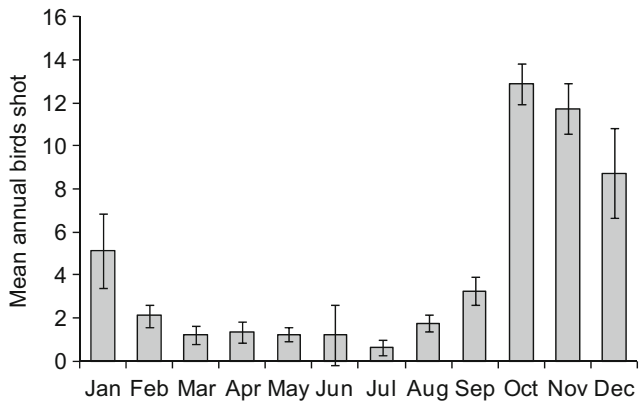

Fig. 3 Seasonal distribution of the number (mean±SE) of shot birds that were admitted to the Gipuzkoa WRC during the period 2006–2013

Discussion

We analyzed the spatial and temporal distribution of illegal hunting (shooting) of birds in Gipuzkoa (north of Spain). Although the data set used here reflected the situation on a relatively local scale, we must notice that Gipuzkoa is situated in a bottleneck area of high importance for bird migration across the East Atlantic flyway (e.g., Galarza and Tellería 2003). We used data from those birds admitted to the Gipuzkoa Wildlife Rehabilitation Center with firearm injuries. These numbers are very likely to be well below real figures, since many shot birds are not recovered (particularly small birds such as numerous passerines, which are under-represented in this study). Even if found, shot birds might not be reported to the authorities. Finally, dead birds would not be admitted to the WRC. In this scenario, we must assume a bias both in the number of birds found and the species detected overall. For instance, an osprey (*Pandion haliaetus*) and a golden eagle (*Aquila chrysaetos*) have been shot in the province during the last 10 years, and these birds do not appear on any official list (M. Olano, personal communication). Not surprisingly, the most frequently admitted birds belonged to the largest species. We must highlight that, although clearly limited, studying the number of injured birds admitted to the WRC is the only systematic way to quantify and analyze the spatial and temporal distribution of the illegal hunting activities affecting these species in Gipuzkoa.

The geographic distribution of illegal hunting (shooting) activities in Gipuzkoa was not homogeneous. The northeastern municipalities of Gipuzkoa were observed to host a high concentration of illegal shooting. This is the most populated area in the province and, consequently, there is a direct link with the possibility of finding a shot bird and/or the number of illegal hunters (here understood as those hunters using firearms to shoot wild birds illegally). Separating both causes is complicated.

Compared with the bulk of birds which were admitted to the WRC, shot birds were found closer to fixed hunting posts. This suggests that illegal hunting (shooting) of birds in Gipuzkoa takes place near or directly from these posts in most instances. Due to the fact that these posts are fixed and hence relatively easily controllable, adequate surveillance around these hunting posts or the application of fines to those post lines where illegal hunting is detected could help reduce this activity.

The temporal distribution of the illegal shooting indicates a direct link with hunting periods, taking place mostly between October and January. Hence, this activity does affect not only local breeding birds but also those individuals on migration arriving in Gipuzkoa via the Atlantic flyway. Gipuzkoa is a region with a significant flow of migrants and hence is of key importance for the protection of birds moving along the East Atlantic flyway (Andueza et al. 2013; Galarza and Tellería 2003; Wernham et al. 2002). Illegal shooting in Gipuzkoa,

accordingly, is likely to affect mostly birds coming from regions situated further to the north, hence constituting an example of how a local problem might have consequences at a continental scale.

The decreasing number of hunting permits issued during the period when the study was carried out was not correlated with the number of birds shot each year, which remained constant. This may be due to the fact that the number of illegal hunters was low and relatively constant throughout the study period. A higher collective effort to control hotspot areas might help to identify these illegal hunters.

Although not comparable with the high numbers of migrants that are shot every year in other south European countries, such as Malta (e.g., Agostini and Logozzo 1997; McCulloch et al. 1992), illegal bird hunting in regions like Gipuzkoa reveals that greater protection standards are necessary.

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