Danish Greylag Goose *Anser anser* use of the Coto Doñana sand dunes for gritting

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Abstract

Four adult female Greylag Geese *Anser anser* tagged with GPS/GSM tracking devices in East Jutland, Denmark migrated to spend the winter of 2021/22 in Coto Doñana, southern Spain. Regular 10-min GPS positions confirmed that three out of the four birds visited the famous Cerro de los Ánsares ("Hill of the Geese") on 1–4 different dates during their time in the study area (total duration = 12–95 days). They almost certainly did so to gather grit to aid digestion (as observed and described in the literature), confirming the persistence of this behaviour reported anecdotally over at least two centuries. The visits of 10–50 min duration were most often immediately after sunrise (although one short visit out of nine total visits occurred in the afternoon) and usually occurred from and to adjacent pools north of the dune system, where the geese feed traditionally on Alkali Bulrush *Bolboschoenus maritimus*. The relatively infrequent visits to the dunes, together with the lack of visits by the fourth bird and also by a Swedish-tagged bird from another study, imply that the geese can obtain grit from other sources within their feeding areas in the marshes and on rice *Oryza* sp. fields in the vicinity. The observations, however, also confirm that this part of the dune system remains an important source of grit for birds feeding nearby, although why they do so here and not elsewhere in the 30 km long and 2–4 km wide dunes remains unclear.

Key words: *Bolboschoenus maritimus*, Cerro de los Ánsares, digestion, grit, grit sites, Guadalquivir, marismas.

Chapman & Buck (1910) were in the company of many on recounting their initial incredulity at encountering large numbers of wintering Greylag Geese *Anser anser* which fed on the Guadalquivir marismas wetlands, coming to "sand themselves" (*i.e.* ingest sand; "*arenarse*" in Spanish) on the bare sand ridge of one of the highest dunes in the Coto Doñana, southern Spain (see Fig. 1). The authors explained this behaviour as herbivorous geese needing to maintain a degree of grit in their gizzard to aid with their digestion, which has since been confirmed by the examination of gizzard

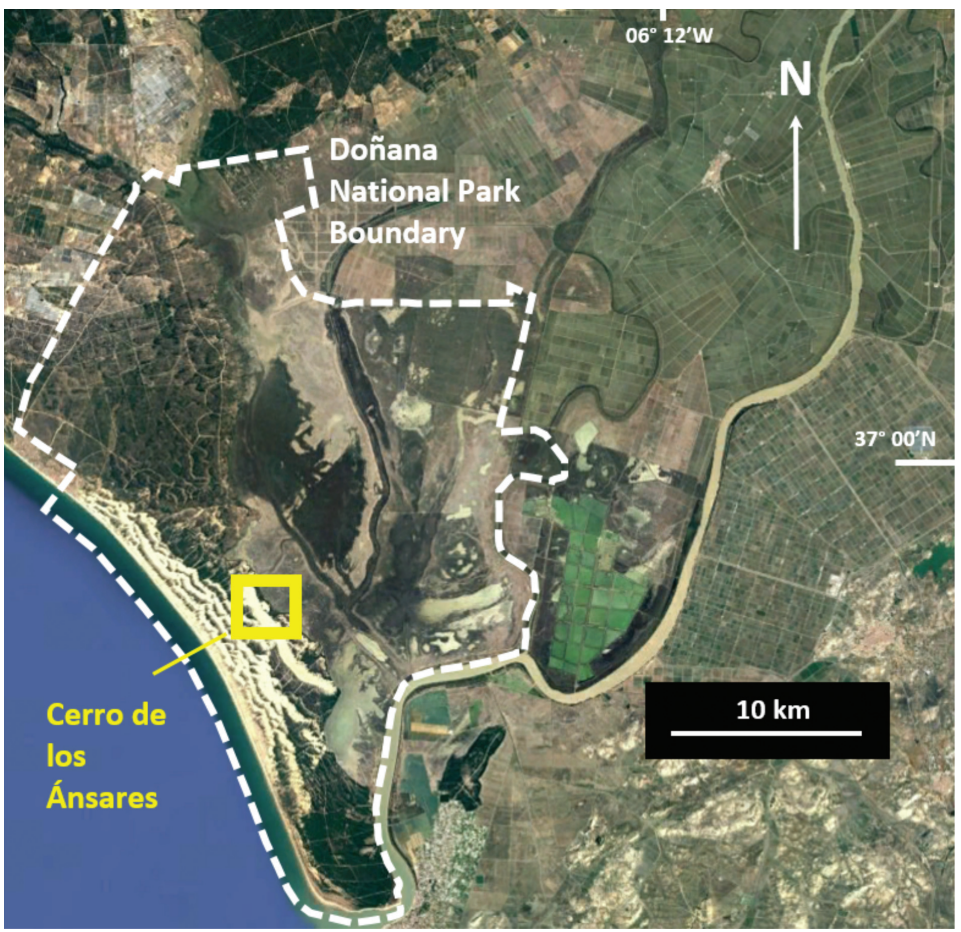

Figure 1. Google Earth image showing the Guadalquivir marismas and the boundary of the Coto Doñana National Park in southern Spain (dashed white line), indicating the key gritting area (outlined in yellow) on the Cerro de los Ánsares, showing the extent expanded in Figs. 3 & 4. The extensive areas of sand dune along the entire coast are very evident from this image, yet Greylag Geese have never been observed using dunes outside of the Cerro de los Ánsares as a source of grit.

contents of birds shot at the site (Amat & Varo 2008). Wild geese are known to require a regular exogenous supply of grit specifically sourced from their environment (*i.e.* more than just coincidentally ingested while feeding), and often travel specifically to gather specific mineral material for the purpose of digestion. For instance, in North America, Lesser Snow Geese *Chen caerulescens* will fly long distances to obtain suitable grit (McIlhenny 1932), to the extent that their predictability enables their capture at such sites (Schroer 1974). Marine-feeding Pacific Black Brant *Branta bernicla nigricans* fly up to 5 km in California to gritting sites (Lee *et al.* 2004; Spragens *et al.* 2013) and Greenland White-fronted Geese *Anser albifrons flavirostris* feeding exclusively on organic raised-mire substrates in Scotland will move to adjacent lakeshore beaches to gather grit (P. Dale, pers. comm.). Aleutian Cackling Geese *Branta hutchinsii leucopareia* also fly to coastal areas to gather grit and to rest (Dahl *et al.* 1999).

Humans have long recognised the importance of grit in the gizzards of avian herbivores to aid digestion, facilitating the mechanical grinding and pulverisation of food within the highly muscular gizzard in the absence of, for example, mammalian molar tooth structures to fulfil the same function (*e.g.* Spallanzani 1783, cited in Gionfriddo & Best 1999; Meinertzhagen 1964). Studies using an artificial gizzard have also confirmed the most effective nitrogen loss from macerated grass occurs in the presence of small quantities of quartzite particles (Moore 1998). Grit size selection varies with diet and between different wildfowl species, but includes many forms of granular material, including dune sand (VerCauteren *et al.* 2003; Figuerola *et al.* 2005) and, on investigating the relationship between Coto Doñana Greylags and their food, Amat & Varo (2008) found a predicted inverse relationship between Alkali Bulrush *Bolboschoenus maritimus* tuber size and the amount of grit (in this case ingested dune sand) in shot geese, based on the expected optimisation of food ingestion. These tubers, which are tough and hard (known locally as "*castañuelas*" – little nuts – in Spanish) are buried in the soil and only available to probing Greylag Geese when the otherwise dry surface of the marshes become flooded and the clay-rich substrate softened. Hence, geese most likely need grit of specific size to assist with digestion, but not to the extent that it could potentially reduce food intake rates due to repletion, taking into account the bottleneck imposed by gizzard size (Amat & Varo 2008; Martinez-Haro *et al.* 2011). Given the likely natural depletion of gizzard grit and egestion in faeces together with other hard items (*e.g.* seeds, García-Álvarez *et al.* 2015) as an unavoidable consequence of digestion, the Coto Doñana Greylag Geese require frequent replenishment of exogenous grit to maintain optimal grit levels of suitable quality to enhance plant matter breakdown in the gizzard.

In winter 2021/22, four Greylag Geese tagged with tracking collars in Denmark in summer 2021 migrated to winter in the Guadalquivir marismas of Doñana, southern Spain. In this contribution, we use data from these devices to describe the frequency and duration of use of the sand dunes by the four individuals during their stay in Coto Doñana, together with the precise locations

used as gritting areas throughout an entire winter.

Methods

We caught 31 Greylag Geese during the brood-rearing period at two sites on Djursland, eastern Jutland, Denmark, by rounding up flightless birds in wet Willow *Salix* sp. woodland and Common Reed *Phragmites australis* reedbeds and walking them into pre-erected nets. Of these, 22 geese (five adult females, five adult males, nine first-year females and three first-year males) were caught at Kastrup Mose, near Pindstrup (56°23'N, 10°22'E) on 7 June 2021, with nine more (an adult pair, five first-year males and two first-year females) captured 14 km due west at Vasen, Clausholm (56°23'N, 10°09'E) on 8 June 2021. We deployed Ornitela OT-N44-3G 45 g Global Positioning System/Global System for Mobile Communication (GPS/GSM) tracking collars on five adult females at Kastrup Mose and on an adult male, an adult female and a juvenile female at Vasen. One of the Pindstrup females was found mortally injured by a predator (probably a Red Fox *Vulpes vulpes*), retrieved and euthanised. The remaining four females all migrated to winter in Coto Doñana in winter 2021/22 following marking, enabling us to track the frequency and duration of the use of the sand dunes (presumably to gather grit) by these individuals throughout their wintering episode at the site. None of the birds from Vasen travelled to Spain, despite the proximity of the two capture sites, so they did not contribute to this analysis. We established a duty cycle for the devices which recorded positions every 10 min throughout the night and day and used simple visual examination of all the sequential positions to determine the relatively few positions (in the day or at night) that occurred in the dune systems. All visits were confined to areas in the yellow rectangle shown in Fig. 1 (the traditional area used by Greylag Geese for gritting, dating back to Chapman & Buck 1910). Allowing for a degree of inaccuracy in the positions generated by the GPS system, we measured the distance between sequential 10-min positions recorded by the GPS on KML file data, presented on GoogleEarth to the nearest 10 m. This enabled us to calculate distances travelled to and from the dunes and the degree of movement by geese during their visits to the dune areas. All these positions from within the dunes recorded instantaneous tag speeds of 0 km h^{-1}, which suggests that the birds were either walking slowly or were stationary during their visits to the dune areas.

The Cerro de los Ánsares is one ridge in an extensive system of mobile dunes within the Coto Doñana National Park and UNESCO World Heritage Site (Fig. 1). The National Park also includes neighbouring natural marshes, and is itself surrounded by areas of lower protection status containing other wetlands, particularly rice *Oryza* sp. fields and fish ponds (Green *et al.* 2018). The wintering population of geese varies between years, reaching peak levels when the marshes are at intermediate depth (Almaraz *et al.* 2012), and facilitating access to Cyperacean tubers. The winter of 2021/22 was exceptionally dry due to low precipitation and the impacts of water extraction for agriculture (Camacho *et al.*

2022), with the result that surface water was relatively scarce (2–4% of normal mid-winter flooding extent since 1985) and, in the southern part of the National Park, restricted to a few lagoons close to the dunes (see Fig. 2). Consequently, goose counts were also exceptionally low: aerial counts located just over 9,000 on 14 December 2021, 12,600 on 18 January 2022, but just 2,200 on 15 February 2022 (Equipo de Seguimiento de Procesos Naturales of the Infraestructura Científica y Técnica Singular de la Reserva Biológica de Doñana *in litt.*).

On 1 February 2012, JJN and others organised two separate early morning flights of a fixed wing ST Easy Fly drone (St-Models, China; see Rodríguez *et al.* 2012 for full methods and detailed specification) at an altitude of 400 m over the Cerro de los Ánsares between 08:00–09:15 h, soon after sunrise. An on-board Panasonic Lumix LX-3 11 MP digital camera integrated into the wing was used to obtain vertical photographs of the Greylag Geese present as part of another study. The position of each individual goose on these images were transferred to a GoogleEarth image and reproduced here for reference and comparison.

Results

One of the tagged females (17596) arrived in Coto Doñana on 27 November 2021 but left after 12 days and travelled north on 10 December 2021 to Embalse de la Colada in Córdoba (38°31'N, 05°00'W), a reservoir 200 km northeast of Coto Doñana, where she spent the remainder of her wintering period in Spain. That bird was recorded at the dunes on one occasion, during her only visit to the pools and wetlands immediately north of the dune system in the very south of Coto Doñana National Park (Table 1). The other three females remained in Coto Doñana for 69–94 days (see Table 1), including female with device 17594 which spent 75 days in Coto Doñana without ever visiting the dunes. The remaining three birds visited the dunes on four, one and four days, during which 12, 6 and 24 positions respectively were recorded (Table 1). None of the tagged individuals visited at the same date/time as any of the other birds and, except for a brief afternoon visit by 17592, all took place in the morning, most likely on departure from the roosts. Goose visits ranged in duration from one position (*i.e.* potentially < 10 min) to 11 (therefore potentially as long as two hours), with a mean of 4.67 positions or a duration of *c.* 50 minutes (Table 1). Based on distance moved between consecutive GPS positions, the birds moved on average 135.3 m per visit (s.e. ± 52.23, range = 0–475 m; Table 1 and see Fig. 3) or a mean of 32.2 m between each subsequent position ($n = 42$), a walking pace of approximately 0.19 km h^{-1}.

Because of the dry conditions (Fig. 2), geese active (and therefore assumed foraging) during the day were concentrated in the relatively small areas of marsh that were flooded, and in the rice fields or at ponds at the Jose Antonio Valverde Visitor Centre (Santoro *et al.* 2010), all of which were flooded with groundwater. Birds mainly flew from overnight roosts in the marshes adjacent to the dunes, presumably to take grit (in which case their flight distance was < 1.1 km, see Table 1). However, on two

Figure 2. Google Earth image showing the extent of standing surface water (coloured dark blue) on 14 January 2022 on the Guadalquivir marismas, Coto Doñana National Park and surrounding areas, based on Landsat images (image courtesy of Miguel de Felipe Toro and Laboratorio de Sig y Teledetección, EBD-CSIC). Note especially the highly limited inundated areas adjacent to the Cerro de los Ánsares, used by the geese indicated in Fig. 3. This image represents 643 pixels shown in blue, reflecting surface water on this date, compared to the more "normal" 15,000–30,000 pixels in mid-winter which characterised 29 out of 38 winters during 1985–2023.

Table 1. Details of the four Danish GPS/GSM tagged Greylag Geese that wintered in Coto Doñana in 2021/22. Columns give arrival and departure times and dates and the number of potential mornings that each individual was present, along with a description of their movements, the number and duration of visits, details of fixes in the dunes, movement length and the distances flown to and from the dunes. Birds active during daylight hours are inferred to be feeding, confirmed by movements detected by the accelerometers in their collars.

Collar code	First time and date at Coto Doñana	Last time and date at Coto Doñana	No. mornings present	General description of tracked individuals' movements	No. days occurring in dunes	No. positions in dunes	Dune use description (all early morning unless specified)	Cumulative distances (m) moved within dunes during each visit	Distances flown to and from dunes for each visit
17592	23/11/2021 17:44 h	02/02/2022 00:36 h	69	Spent day of 26/01/2022 on marsh east of the river (at 36°59'N, 06°14'W). Otherwise, only daytime activity in marshes was immediately north of the dunes, in the southern part of the national park.	4	12	2 fixes: 25 November 2021; 4 fixes: 30 November 2021; 1 fix: 21 December 2021 (afternoon); 5 fixes: 26 January 2022	20; 360; 0; 120	750 m; 770 m; 540 m; 2 km; 800 m; 2 km; 7 km; 18 km
17594	23/11/2021 17:04 h	07/02/2022 21:23 h	75	Daytime activity in wetlands throughout the area, including marshes immediately north of the dunes and in Hato Blanco rice fields (37°08'N, 06°20'W).	0	0	Never visited	-	-

Table 1 (*continued*).

Collar code	First time and date at Coto Doñana	Last time and date at Coto Doñana	No. mornings present	General description of tracked individuals' movements	No. days occurring in dunes	No. positions in dunes	Dune use description (all early morning unless specified)	Cumulative distances (m) moved within dunes during each visit	Distances flown to and from dunes for each visit
17596	27/11/2021 21:30 h	10/12/2021 07:29 h	12	Main daytime activity in rice fields (at 37°08'N, 06°20'W); few days at El Rocio; one visit to the southern pools by the dunes, flying down 07:20 h 04/12/2021 returning 07:00 h 05/12/2021. Left Donana 10/12/2021 for Embalse de la Colada, El Viso.	1	6	6 fixes: 4 December 2021	130	15.5 km; 600 m
17599	06/11/2021 17:14 h	08/02/2022 18:45 h	94	Daytime activity throughout the area, including marshes immediately north of the dunes and in rice fields (37°08'N, 06°20'W).	4	24	11 fixes: 20 November 2021; 2 fixes: 26 November 2021; 4 fixes: 29 November 2021; 7 fixes: 01 January 2022	475; 4; 200; 440	15.5 km; 800 m; 900 m; 600 m; 700 m; 1 km; 1.1km; 1.3 km

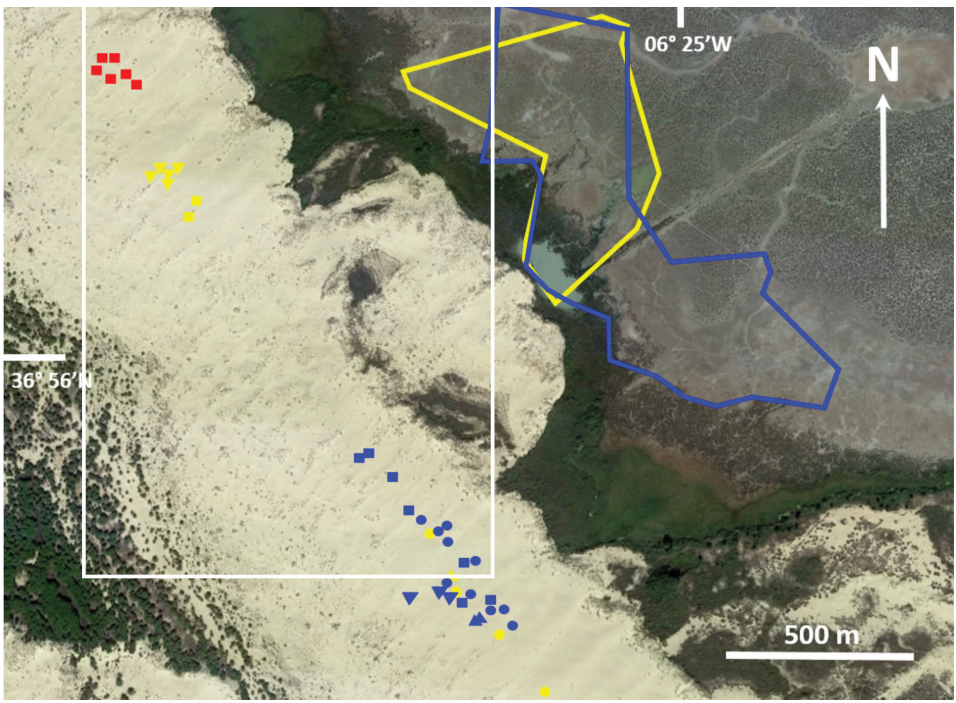

Figure 3. GoogleEarth image showing locations of the three Danish tagged Greylag Geese during their gritting visits to the dunes in Coto Doñana, identified by the yellow square in Fig. 1. Yellow symbols indicate positions of tag 17592, squares indicate 25 November 2021 (two positions), circles 30 November 2021 (four), triangle 21 December 2021 (one) and inverted triangles 26 January 2022 (five). Red squares indicate positions of tag 17596 on 4 December 2021 (six, the only visit to the dunes). Blue symbols indicate positions of tag 17599, circles indicate 20 November 2021 (11, two of which are superimposed on each other), triangles 26 November 2021 (two), inverted triangles 29 November 2021 (four) and squares 1 January 2022 (seven). Yellow and blue polygons outline the stationary positions on feeding areas used by 17592 and 17599 respectively, at the times of their visits to the dunes shown here. The nearest feeding area of 17596 lies 200 m north of the upper edge of this image, areas also used by the other two birds on these dates. The white rectangle delineates an area covered in the drone photograph featured in Fig. 4, showing the previous instantaneous distribution of gritting Greylag Geese on 1 February 2012.

occasions, geese flew from their overnight roost site by the Visitor Centre (a direct distance of 15.5 km), giving an overall mean flight to the dunes of 4.75 km. Geese left the dunes to go to their next daytime site where they were once more active, but relatively stationary, situated at a mean distance of 3.22 km from the dunes. On 78% of occasions, they headed to the marshes within 2 km to the north of the dune system (Table 1), which also held water at this time (Figs. 2 & 3). Since these putative

feeding areas (as well as those further north) comprise Cyperacean (*Bolboschoenus maritimus* and Club-rush *Schoenoplectus litoralis*) dominated wetlands, it is likely that rhizomes of these plants were the food items consumed in these areas, which require the geese to obtain grit (Amat 1986; Amat & Varo 2008). The areas used were in the same locality as those used by geese photographed during the two drone flights of 1 February 2012 (Fig. 4).

Discussion

The use of the Cerro de los Ánsares by wintering Greylag Geese is well documented in recent decades (Amat 1986; Mateo *et al.* 2000; Martinez-Haro *et al.* 2013), but we present here the first accounts of the overall frequency and duration of visits by individual geese to the sands of the dunes when wintering in the area. Counts by the Estación Biológica de Doñana – Consejo Superior de Investigaciones Científicas (EBD-CSIC) monitoring team over the years show consistently that the numbers of geese visiting the dunes on a given day are much lower than the total numbers present in Doñana. However, prior to our investigation, questions remained as to whether all geese visited the dunes at some point in the winter, or whether only a subset of individuals visited with some of them visiting daily. These results are the first to address the individual behaviour of Greylag Geese wintering in the Guadalquivir marshes in southern Spain. They confirmed that, during the drought conditions of 2021/22, tagged birds from Denmark utilised the sand dunes of Cerro de los Ánsares, Coto Doñana presumably to obtain grit, as these geese have done for centuries (as described in hunting chronicles even prior to Chapman & Buck 1910). The tracking also showed important individual variation – both in frequency of visits and in the precise locations used within the dune system – and that none of the tagged individuals made daily visits to the dune.

Whilst the results showed that only three out of the four tagged individuals visited the dune system at all, they all used a particular section that has been used prevalently in the past, *e.g.* coinciding with the distribution of sanding geese in February 2012 (see Fig. 4). In addition, a fifth goose GPS-tagged in Örebro, Sweden for a separate study, was tracked through winter 2018/19 in Coto Doñana but did not visit the dunes during its stay (Månsson *et al.* 2022; C. Olsson, pers. comm.). The tracking confirmed that all of the Danish birds recorded on the dunes used the same stretch of Cerro de los Ánsares (centred on 36°55'58"N, 6°25'33"W), which is the highest and longest sand dune ridge in the National Park (see Fig. 1), as well as the first that the geese encounter when flying from the marshes. The ridge is practically devoid of vegetation on its crest, but there is nothing obviously visibly special about the sand there compared to elsewhere along the 30 × 2–4 km stretch of dune systems along this coast. However, the lack of vegetation and especially trees means that the specific area used is more accessible (for ease of landing and take-off) for the sometimes thousands of birds, which historically have used the ridge simultaneously. The extreme lack of cover for local predators (Red Fox and the endemic Iberian Lynx *Lynx pardinus* and

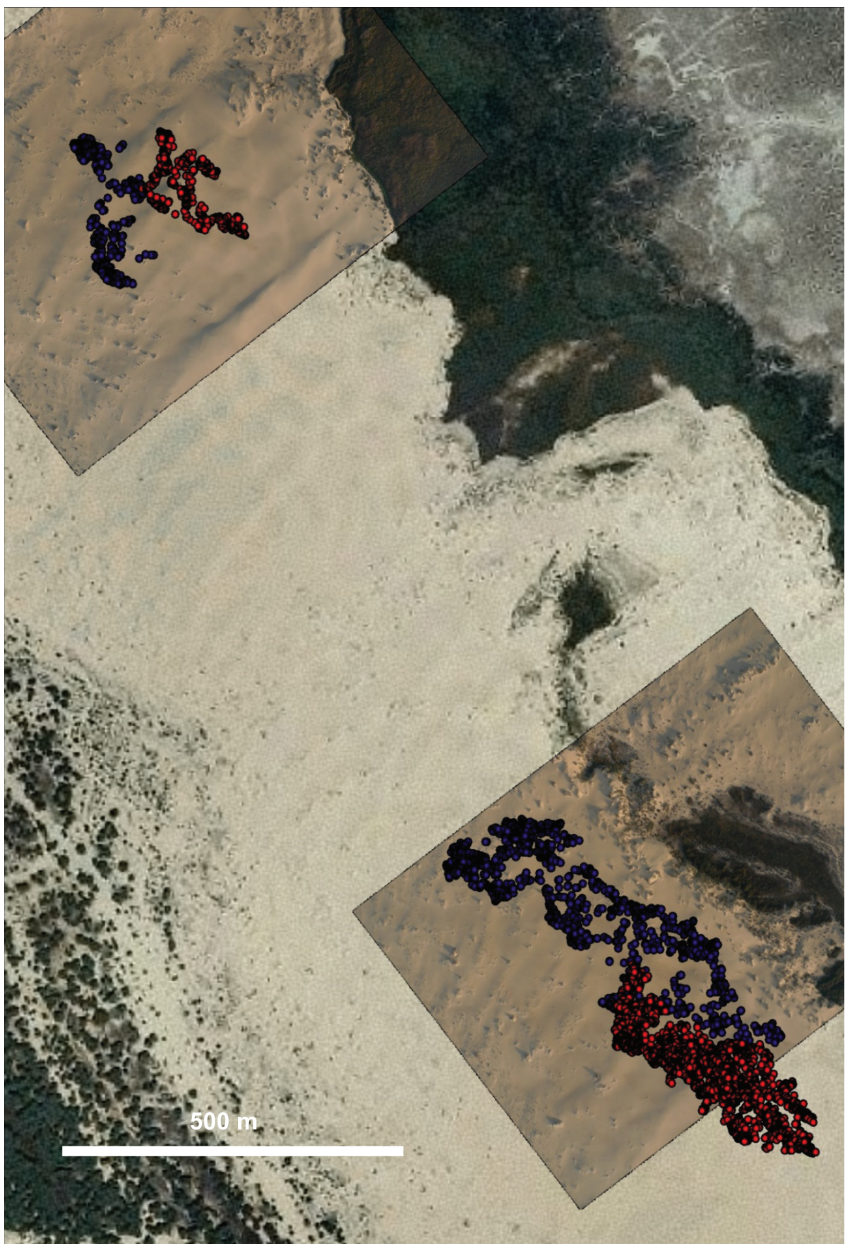

Figure 4. Distribution of Greylag Geese in Cerro de los Ánsares, derived from vertical photographs taken from a fixed wing drone (see Methods for details). Red and blue dots indicate individual goose positions during two separate flights on 1 February 2012. Darker rectangles are an artefact from image processing to highlight relief in the dunes.

Spanish Imperial Eagle *Aquila adalberti* being the most significant predators of geese at the site) may also contribute to the extraordinary fidelity of geese to this place, apparently over many centuries (Chapman & Buck 1910).

Our results confirm the impression that Greylag Geese wintering on the marismas of the Guadalquivir appear highly motivated to return to this particular part of the dunes to obtain grit in the form of sand, even though their sanding here formerly attracted the attention of one major predator species. In earlier times, one of the three main methods of shooting Greylag Geese wintering on the marismas of the Guadalquivir was on the morning flight when these geese habitually came to "take sand" on the dunes at dawn. Chapman & Buck (1910) considered that individual geese had no cause to replenish gizzard grit more than once a week or less frequently, so geese coming to take sand the day after a shoot would potentially not have experienced the previous hunt, with the result that Chapman & Buck (1910) could report shooting remarkably large numbers. Although not constituting proof, their observations may confirm ours in that none of our marked geese returned to sand every day. Indeed, the site was an incredibly popular resort for hunters, who with royal patronage were able to shoot large numbers of Greylag Geese until winter 1982/83 (when hunting was stopped; Ramo *et al.* 2013), yet the birds kept coming anyway. In the past, hunters used "cimbeles" (artificial decoy birds, but also sometimes domesticated geese with wild phenotypes) to lure the birds close to the places where hunters waited hiding in barrels buried in the sand (Camoyán 2007). Chapman & Buck (1910) recorded daily kills of 23–59 geese during 1903–1910 from their concealed hunting hides on Cerro de los Ánsares and remarked that they thought it surprising that large numbers returned with such regularity despite the disturbance from hunting. More recently, Camoyán (2007) described three hunters shooting 82 geese in one session in the early 1980s and previous accounts of up to almost 500 being killed there in one day. This form of hunting has left a legacy in the form of accumulations of lead shot (16.2 pellets/ha present in the upper 20 cm layer of Cerro de los Ánsares in 1997; Mateo *et al.* 2000) in the upper horizons of the sand precisely in the area used by the geese to ingest grit. Efforts to remove some of the lead shot pellets from Cerro de los Ánsares, together with restrictions on hunting there since 1983, is thought to have contributed to the decrease in the prevalence of ingested lead shot in Greylag Geese wintering in Coto Doñana (Mateo *et al.* 2000, 2007; Martinez-Haro *et al.* 2013).

Numbers of Greylag Geese in the Northwest/Southwest European population, to which these geese belong (Bacon *et al.* 2019), have been increasing in recent years (Powolny *et al.* 2018) but the wintering centre of gravity of the entire flyway population has moved north and east as more geese winter nearer their breeding areas (Ramo *et al.* 2015). As a result, Greylag Geese are increasingly occurring at wintering sites in Spain away from Coto Doñana, although the majority of the Spanish-wintering birds still occur there (Ramo *et al.* 2015). There is also a marked trend for geese to arrive progressively

later to Coto Doñana since the 1960s, and to leave earlier (Ramo *et al.* 2015). It is impossible to evaluate historical censuses conducted prior to the first aerial counts, and since 1978 there has been no clear population trend using maximum counts in a given winter. However, strong fluctuations in numbers between years (Rendón *et al.* 2008; Almaraz *et al.* 2012) are likely linked to some degree to hydrological conditions which affect food availability (*e.g.* Wachtel 1981). Furthermore, the reduced time spent wintering in the area has translated into declines in mean counts during the winter period. As a footnote, two of the four tagged geese tracked in Coto Doñana in winter 2021/22 during the period of poor feeding conditions did not survive to winter 2022/23, but the remaining two (tags 17592 and 17594) wintered in Djursland, eastern Jutland, Denmark and on the German Waddensee, respectively. This is the first evidence we have of individual Danish-nesting Greylag Geese showing full winter short-stopping (*sensu* Elmberg *et al.* 2014), which would contribute to the explanation for increasing wintering numbers further up the flyway and in Denmark (Ramo *et al.* 2015; Powolny *et al.* 2018; Holm *et al.* 2021; Clausen *et al.* 2023).

Eight out of nine visits by tagged birds to the dunes were soon after sunrise, with the one exception of a brief afternoon visit by 17592, suggesting a perceived need to take grit before the onset of daylight feeding. Three out of four birds spent the night in the same area of pools adjacent to the dunes to which they returned after sanding and we are not aware of any evidence that they feed there at night. Our own visits to the dunes when geese are present suggest that first light is an optimal time for visiting because the dew accumulated during the night creates saturated patches of sand, which may make ingestion more straightforward for the geese. This water rapidly evaporates once these patches are sunlit, potentially contributing to the explanation for their spatial and temporal exploitation of this particular dune crest.

The four tagged geese spent between 12 and 96 days in the region, considerably fewer than the four months total wintering period of Sánchez *et al.* (1977). Nevertheless, the time periods spent wintering in the region imply the geese can probably obtain grit from other sources within their feeding areas, something Chapman & Buck (1910) asserted in their day. The tracking also supported their earlier observations, namely that geese did not obtain sand from other parts of the extensive sand dune chain of this part of the coastline away from Cerro de los Ánsares. The completely flat alluvial mud that forms the lowest levels of the Guadalquivir marismas are interspersed with slightly raised ridges of sand and grit, known as *vetas* (tongues) which, when not covered with floodwaters may provide the geese with alternative sources of gizzard grit (presumably the remnants of eroded mollusc shells) when feeding in their vicinity. However, these features are often colonised and subsequently overgrown with vegetation, restricting their access to geese and potentially hiding predators. When water levels are high and these features are inundated, the geese have been frequently reported flying to Cerro de los Ánsares

outside of the marismas to replenish depleted gizzard grit with sand (*e.g.* Chapman & Buck 1910). Greylag Geese have been feeding on rice fields adjacent to the National Park since the 1950s, and when feeding there and on areas of early succession restored marsh in the Caracoles estate (Sebastián-González & Green 2014), the geese have also been seen obtaining grit from the many gravel tracks that intersect those areas (JJN & AJG, pers. obs.).

Intriguingly, the development of the dune system south of the town of Matalascañas is a relatively recent feature (< 3,000 years old); the marshes were an open estuary to the sea in Roman times (Rodríguez-Ramírez *et al.* 2014) and the Cerro de los Ánsares is less than 1,400 years old (Goy *et al.* 2022). Hence, the use of the gritting site of Cerro de los Ánsares can only be a relatively recent phenomenon that started in the last two millennia as the dunes and marshes came into being. However, these contemporary observations at least confirm that this part of the dune system of Coto Doñana remains an important source of grit for Greylag Geese, especially those feeding on nearby *Bolboschoenus maritimus* in the marismas.

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Photograph: Greylag Geese alighting at Cerro de los Ánsares, by the late Pepe Pérez de Ayala.

Photograph: Three Greylag Geese looking over the dunes, by the late Pepe Pérez de Ayala.