Influence of supplementary food on the behaviour of Greylag Geese *Anser anser* in an urban environment

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Abstract

Feral Greylag Geese *Anser anser* were studied in Stuttgart, Germany, in autumn and winter 2004/05 to determine whether the provision of supplementary food, mainly bread, affected their behavioural patterns. The birds' activities, recorded by flock-scans made at regular intervals throughout the day, were compared for days with and without supplementary food. The main activities recorded were feeding and loafing in both circumstances, but the proportion of time that the birds spent feeding was significantly lower on days when food was provided (43%) than on days when they grazed on the town's lawns without any additional food (67%). Conversely, the amount of time that the birds spent loafing was higher on days when fed by the public (25%) than on days when they were not (14%). The difference in diurnal patterns was most evident from 13:00 h onwards, which coincided with the increase in the provision of food in the second half of the day. When supplementary food was available, vigilance behaviour also doubled from 8% to 16%, and more social interactions (mainly agonistic behaviour) and locomotion were observed.

Key words: *Anser anser*, activity budget, Greylag Goose, supplementary food.

Although people feed birds on bread and grain in many cities around the world, local governments often prohibit feeding for public hygiene and for conservation reasons. For instance, a concentration of birds attracted by the food supply may result in eutrophication of lakes and change the ecology of these water bodies (Manny *et al*. 1994; Unckless & Makarewicz 2007). If new ponds or lakes are being created the birds may also feed on planted vegetation, thus slowing ecological succession at these sites. The feeding of birds therefore may conflict with other conservation measures in some areas. The effect of waterfowl droppings on the environment has been assessed (Ganning & Wulff 1969; Harris *et al*. 1981; Manny *et al*. 1994; Unckless & Makarewicz 2007), but the effect of supplementary feeding on the urban goose flocks themselves is poorly documented.

A flock of feral Greylag Geese *Anser anser* became established in Stuttgart, southwest Germany, in the 1980s. By 2004, the flock had increased to 159 individuals. The geese are rather tame and are used to people feeding them with bread. This study aims to compare the activity budgets of the geese on days with and without supplementary feeding, and thus to determine whether the provision of food has a significant effect on their behaviour patterns during the day.

Methods

Study area

The study was conducted between October 2004 and March 2005 at two locations in Stuttgart, southwest Germany (48°46'N, 09°10'E): in the parks in town and at Max-Eyth Lake seven kilometres to the north along the River Neckar. Stuttgart's public parks extend over eight kilometres, with the lawns of Rosensteinpark, Untere, Mittlere and Obere Anlagen providing ample grazing for the geese. Max-Eyth Lake is a former gravel pit now popular for recreational purposes. The northwest part of the lake is protected for wildlife, particularly birds. The geese use islands in this area of the lake for nesting and graze on pasture around the edges of the lake.

Activity budgets

Behavioural observations of goose flocks were carried out 2–4 times per week between November 2004 and March 2005 for a total of 40 days. Activity budgets recorded on days with supplementary feeding (n = 7 days; 63 h) were compared to

a randomly-chosen equal number of days without supplementary feeding (n = 7 days; 63 h). These 14 days of observation were chosen from days when no snow cover was present, because snow cover is known to influence the birds' behaviour (Käßmann & Woog 2007). Days with supplementary feeding were defined as those on which people fed bread or grain for a minimum of 2 h or on at least 12 occasions per day.

The behaviour of all geese present in an area was determined by taking scan samples from dawn to dusk (Martin & Bateson 1986). In each flock-scan, all birds in the flock were checked, and their behaviour when first seen was recorded, working systematically from one side of the flock to the other. An audio beeper gave a signal to start the flock-scan at 10 min intervals. Behavioural categories, modified from those used by Inglis (1977), included feeding on grass, feeding on bread, vigilance, loafing, locomotion, preening and social interactions (mainly aggression). Data were grouped by hour, the first hour being observations made from 08:00–08:59 h and the last from 17:00–17:59 h. Only data recorded during daylight hours were used in the analyses.

Statistics

Variation in the time the geese spent on three main activities: feeding, loafing and being vigilant, were compared using analysis of variance with a binomial error distribution in GLIM (Crawley 1993; NAG 1993). We analysed a) daily activity and b) hourly activity, for days with supplementary feeding compared with days without

supplementary feeding. Because the data recorded for the different behavioural categories were not independent of each other, they were tested separately. For instance, the mean number of birds exhibiting a certain behaviour (e.g. feeding) within an hour was the response variable, and the mean number of birds monitored within an hour was the binomial denominator. Explanatory variables tested in the models were observation day (included as a factor in the model), the presence/absence of supplementary food that day, location and hour (time of day). For days with supplementary food, the association between the number of times that food was provided per hour (range: 0–5 occasions) and goose behaviour was also tested. As date and location did not cause a significant increase in deviance, data from all days and locations were pooled in the analyses presented here.

Initial fits to the models indicated that the behavioural data were over-dispersed. An estimate of the scale parameter, obtained by dividing the Pearson χ^2 value of the model (*i.e.* the system scalar) by the degrees of freedom, therefore was used to set the scale directive for the model (Crawley 1993). Variables that caused a significant increase in deviance ($P < 0.05$) on being removed from the maximal model were retained; non-significant variables were omitted from the final model. Biologically meaningful interaction terms, such as an interaction between time of day and the presence/absence of supplementary food, were tested but none were found to be statistically significant.

Results

The daily percentage of activities differed on days with frequent supplementary feeding compared to days without (Fig. 1a,b and Table 1). The percentage of geese recorded feeding during the day was more than one third lower on days when supplementary food was provided (43%) than on days without people feeding the birds (67%). However, only 3% of the birds were recorded feeding on bread on days when it was offered (Fig. 1a). Significantly more time was devoted to loafing (25% versus 14%) and the percentage of time being vigilant was twice as high (16% versus 8%) on days with supplementary food. Furthermore, an increase in social interaction (mainly aggression) was observed. There was no significant difference in the percentage of preening and locomotion.

There was a marked difference in the hourly activity patterns of the geese on days with and without supplementary food (Fig. 2 and Table 2). Until 13:00 h, the proportion of birds recorded feeding and loafing showed similar characteristics under both circumstances, with a high proportion of geese feeding on grass from 08:00 h onwards, but with feeding activity decreasing towards noon as the proportion of loafing activity rose. Thereafter behavioural patterns on days with and without supplementary food differed increasingly. However, with an increase in the number of supplementary feeding events during the afternoon, the percentage of geese grazing decreased to a minimum of

Table 1. Association between supplementary feeding and Greylag Goose activity over seven days with supplementary feeding and seven days without additional food sources.

Activity	Mean time with supplementary food (%)	Mean time without supplementary food (%)	$F_{1,143}$	P
Feed	43	67	39.00	< 0.01
Loaf	25	14	25.42	< 0.01
Vigilant	16	8	24.58	< 0.01
Social interaction	1	<1	30.16	< 0.01
Preen	6	4	2.62	n.s.
Locomotion	9	7	0.07	n.s.

(a) Days with supplementary food
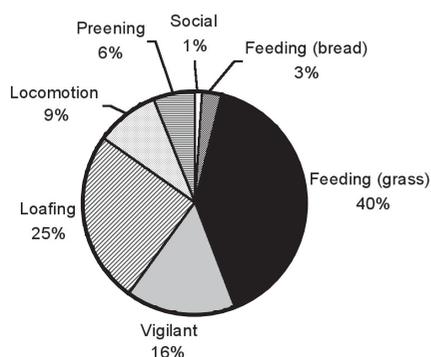
(b) Days without supplementary food
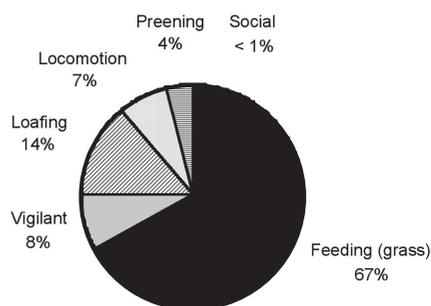
Figure 1. Activity budgets of Greylag Geese on (a) days with supplementary food (*n* = 7) and (b) days without additional food sources (*n* = 7). The mean percentage of time recorded for each activity is shown (*n* = 63 h each, for (a) and (b) respectively). Average flock size was 31.0 birds for days with supplementary feeding and 43.9 for days without additional food.
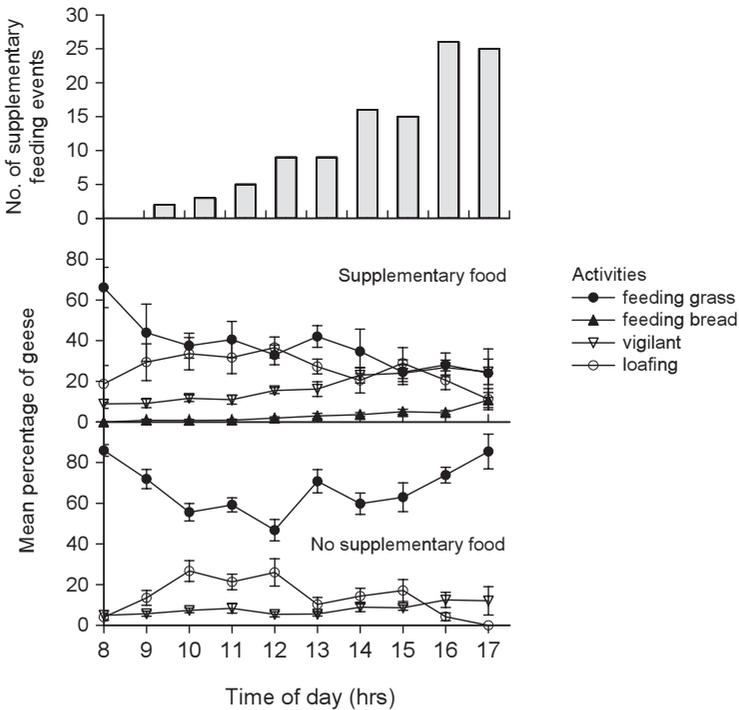
Figure 2. Average percentage (± s.e.) of Greylag Geese recorded feeding (on grass or on bread), loafing and being vigilant, for each hour of the day, on days with and without supplementary food. The top graph shows the total number of feeding events (provision of supplementary food) per hour. Sample size for days with supplementary food: *n* = 6 days at 08:00 and 17:00 h; *n* = 7 days for all other hours. Sample size for days without supplementary food: *n* = 4 days at 17:00h; *n* = 7 days for all other hours.

24% between 17:00–18:00 h, at which time the percentage of birds feeding on bread was highest (10%; Fig. 2). In contrast, when no supplementary food was available the percentage of geese grazing increased again throughout the afternoon and reached a second day peak between 17:00–18:00 h (86%) when no birds were loafing and the percentage being vigilant was highest (12%). On days with supplementary food, vigilance behaviour increased to levels of 27% between 16:00–17:00 h and 25% between 17:00–18:00 h, with still 11% of the birds seen loafing between 17:00–18:00 h. Most supplementary feeding of the geese took place between these hours (26 and 25 feeding events, respectively; Fig. 2).

On days when supplementary food was provided (*n* = 7), goose behaviour was associated with the number of feeds per hour

Table 2. Association between supplementary feeding and Greylag Goose activity on including the time of day (h) in the Generalised Linear Model.

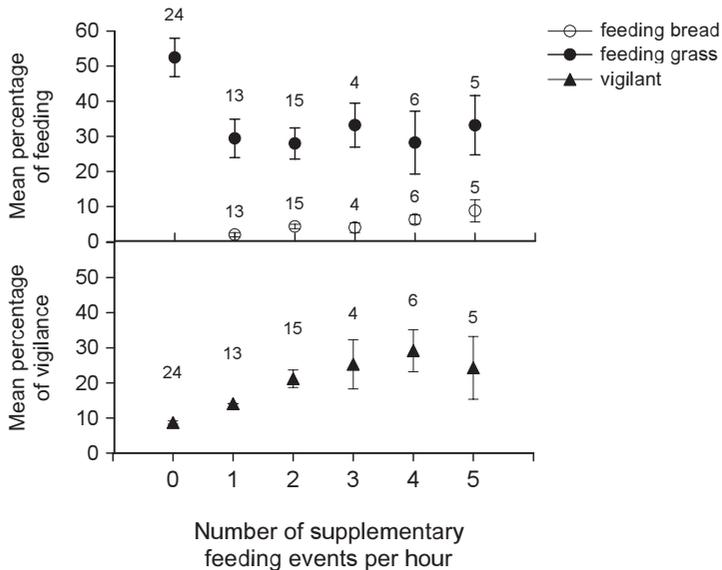|	Supplementary feeding (present/absent)		Time of day (h)	
	$F_{1,133}$	P	$F_{10,142}$	P
Feed	42.63	<0.01	2.64	< 0.01
Loaf	28.69	<0.01	2.67	< 0.01
Vigilant	27.78	<0.01	3.95	< 0.01
Social interaction	28.69	<0.01	1.10	n.s.
Preen	3.24	n.s.	3.21	< 0.01
Locomotion	0.07	n.s.	2.31	< 0.01

Figure 3. The mean percentage of geese recorded feeding and being vigilant (+/- s.e. bars), in relation to the number of supplementary feeding events per hour, on days when supplementary food was provided (*n* = 7 days).

(Fig. 3). The birds grazed more when no supplementary feeding occurred ($F_{6,67} = 2.61$, $P < 0.05$), whereas the proportion recorded as vigilant increased with the number of feeds per hour ($F_{6,67} = 6.14$, $P < 0.01$). No significant pattern was found for loafing, locomotion, preening or social interactions (loafing: $F_{6,67} = 0.83$; locomotion: $F_{6,67} = 2.06$; preening: $F_{6,67} = 1.60$; social interactions: $F_{6,67} = 2.03$; n.s. in each case). Locomotion was less frequent when no food was offered, increased significantly when birds were fed once an hour, but reduced again when more feeding events per hour occurred. Time of day was never significant in models that included the number of feeding events per hour.

Discussion

The main activities of the feral Greylag Geese in Stuttgart were feeding and loafing, which is similar to the behaviour of wild goose populations (Amat 1986; Desnouhes *et al.* 2003). However, the provision of supplementary food appeared to alter their activity budgets considerably. Although the availability of such additional food sources always remained very low, and only 3% of birds were recorded feeding on bread during the flock-scans, the percentage of geese feeding on grass was disproportionately lower on days when supplementary food was provided. This may be beneficial for the geese: on days when supplementary food was available, the birds could reduce the amount of time feeding on the less easily digestible grass (Buchsbaum *et al.* 1986; Prop & Deerenberg 1991; Prop & Vulink 1992)

and spend more time in other activities such as loafing, vigilance and social interactions (*i.e.* agonistic behaviour), having gained a greater energy intake over a shorter time period by feeding on bread or grain than they would have achieved by grazing. Similar results have been shown for Mute Swans *Cygnus olor* (Ryley & Bowler 1994; Sears 1989). Although the provision of food could favour dominant birds in the flock, lower ranking birds may be displaced in competition for a concentrated and limited food source (Kotrschal *et al.* 1993; Milinski & Parker 1991; Sutherland & Parker 1985). These individuals may even loose energy in competing unsuccessfully for food, and supplementary feeding therefore may be harmful to them. More careful observations of how humans dispense the food would help to clarify this point, to see if they throw food to birds at the back of the flock, and whether this is taken by subordinate birds.

The provision of supplementary food caused changes in goose behaviour and had an increasing effect upon the grazing rhythm throughout the day. The significant decline in grazing during the second part of the day was not proportionate to the very slight rise in the number of geese feeding on bread. Especially in the afternoon, when many people were around, most geese seemed to be fixated on potential food offerings, as indicated by an increase in vigilance behaviour. The vigilance was not due to the birds being alarmed by humans; they frequently walked after feeding pedestrians and begged for food, or even flew short distances from one bread distribution point to another. Although the supplementary food may be beneficial to the

geese, becoming dependent on humans for food may make the birds vulnerable, for instance if the additional food supply is withdrawn, or through relatively tame birds becoming easy prey for vandals (Sears 1989). Thus for the birds' welfare, as well as for reasons such as public hygiene and eutrophication of urban lakes associated with the birds' droppings (Manny *et al.* 1994; Unckless & Makarewicz 2007), the costs and benefits of supplementary feeding in urban environments should perhaps be reviewed.

Acknowledgements

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