Population size and feeding behaviour of Andean Geese at Lake Junin, Perú

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Introduction

The Andean Goose *Chloëphaga melanoptera* (known as the Huallata or Huashua in the Quechua language of the Peruvian Indians) is one of five species of sheldgeese (Tadornini), all of which are restricted to South America. The Andean Goose occurs along the Andes from 8°S in Peru to 33°S in Argentina and 38°S in Chile (Hellmayr 1932; Goodall *et al.* 1951; M. Plenge pers. comm.) where they nest above 3,000 m. In winter some migrate down to about 2,000 m (Casares 1934; Goodall *et al.* 1951) and are rarely found at sea level (Pearson and Plenge 1974).

The little that is known about the Andean Goose is based on casual observations by field naturalists or observations made in waterfowl collections (Castillón 1918; Casares 1934; Delacour 1954; Koepcke and Koepcke 1965; Johnsgard 1965, 1978; Rossi 1967; Weller 1968). Large numbers gather in winter at Lake Junin, Perú, and in this study we describe the numbers, distribution and feeding behaviour of this population. Comparisons are also made with the sheldgeese which winter in the Falkland Islands: thus comparing species which winter at high latitudes with the Andean Goose which occurs at high altitudes.

Study area

Lake Junin is a large lake (28 x 13 km) at an altitude of 4,078 m in the Andes, 300 km east of Lima. The habitats and ecology in and around the lake have been described by Dourojeanni *et al.* (1968) and a recent account of the waterbirds is given by Harris (1981). The climate is cold (annual average temperature is between 3 and 6°C) and most of the rain (400–800 mm) falls in summer. The plant associations belong to the "Páramo húmedo sub-alpino" and "Tundra muy húmedo-alpino" formations of the Holdridge classification adapted by Tosi (1960).

The drier pastures around the lake are intensively grazed by thousands of sheep and smaller numbers of cattle, horses and llamas. Pigs roam freely and forage among the muddy water channels. The wet pastures on which the geese forage are composed almost entirely of short-leaved (1–4 cm) fleshy plants. The following other plants were recorded: mosses, *Nostoc* sp. (Nostocaceae), *Chara* sp. (Characeae), *Myriophyllum* sp. (Halorrhagidaceae), *Hydrocotyle* sp. and *Lilaeopsis* sp. (Umbelliferae). Grasses (Gramineae) are rare in this habitat.

Methods

The lake was visited between 1 and 4 September 1984. Birds were searched for by touring the roads and tracks round the lake and periodically scanning the surrounding area with binoculars and a x15–60 telescope.

On 3 September the diurnal activity of geese was recorded each 20 minutes from sunrise to sunset, from a sample of about 150–200 geese in each 20 minute period (Altmann 1973). The following activities were recognised; "grazing", "walking", "standing", "agonistic behaviour", "flying", "sitting", "preening", "drinking", "swimming" and "bathing". The percentage of the day spent in different activities was calculated by taking the mean percentage of birds carrying out each activity in each 20 minute period.

Food intake was calculated indirectly from estimates of daily production of faeces and digestive efficiency, using the cell-wall material (cellulose, hemicellulose and lignin) as an indigestible marker (Ebbinge *et al.* 1975). Summers and Grieve (1982) have shown that this method gave similar results to a direct determination of digestive efficiency in the Upland Goose *Chloëphaga picta*. Intervals between successive defaecations (the interfaecal period) were measured with a stopwatch whilst geese were observed through the telescope (Owen 1971). Fresh faeces were collected and samples of the herbage were clipped, dried to constant weight in an oven at 60–90°C, weighed, and the organic content, calorific value and cell-wall content measured.

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Statistics are given in the form of mean ± standard deviation. DM = dry matter and OM = organic matter. Time of day is given as hours:minutes.

Results

Numbers and distribution

Most of the geese were encountered in the area to the east of Paucarcoto and smaller groups occurred on the west side of the lake (Figure 1). The total number counted was 1,887.

The geese at each locality occurred in pairs or loose flocks which, at Paucarcoto, numbered several hundred individuals. The flocks also contained pairs and presumably family groups since young of other sheld-geese tend to remain with their parents for about eight months after fledging (Summers 1983). However, first-year Andean Geese are not readily distinguished from adults at this time of year.

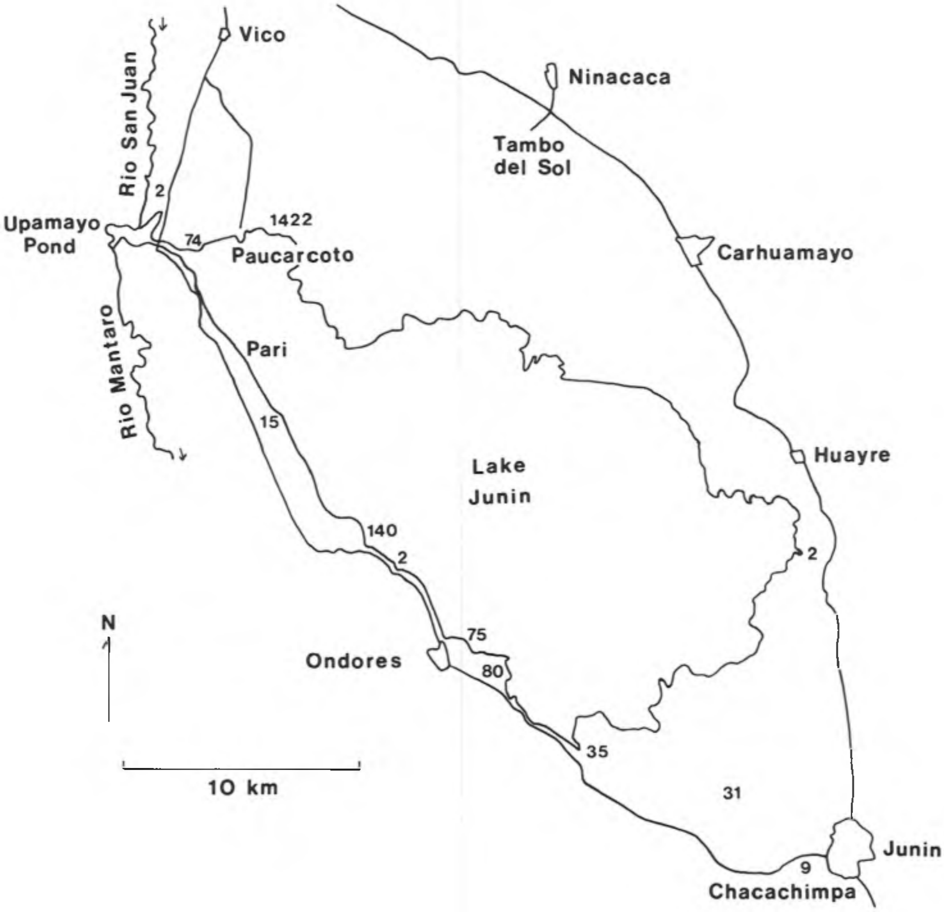

Figure 1. Lake Junin and surrounding villages and roads. Numbers indicate the number of Andean Geese at each locality.

Diurnal activity

Observations at Paucarcoto started a few minutes after sunrise (06:15 hours), though it had been light for about half an hour. Most geese were still along the shore of the lake where they presumably roosted overnight. Initially, no feeding was observed and most geese were standing or preening at the water's edge. Flocks of geese soon began to take off and fly 0.5–1 km inland to the surrounding marshes where they grazed throughout the day. Between 06:20 and 07:30 hours it was extremely cold and frost covered the ground, and it was not until about half the frost had melted that grazing became intense and formed the main activity for the day (Figure 2, Table 1). The percentage of time spent grazing then declined through the middle of the day, but intensified again in the latter part. The percentage of birds sitting was greater in the afternoon compared with the morning. Also drinking was more common in the afternoon, but the percentage preening, walking and standing showed little variation through the day, apart from around sunrise and sunset (Figure 2). Agonistic behaviour took the form of aggressive posturing (males), inciting behaviour (females) or short chases (Johnsgard 1965) and formed only a small percentage of the diurnal activity despite the high density of geese. Shepherds tending flocks of sheep occasionally put up the grazing flocks of geese causing them to fly a few hundred metres to an undisturbed locality. Generally, there was little overlap in the habitats used by sheep and geese since the former were found grazing on the dry pastures, and the geese were on wetter areas. The geese started to fly back to the roost site on the lake shore about half an hour before sunset. Shortly after sunset practically all the population had left the pastures and were present along the shore of the lake. Bathing and swimming were noticed at this time.

Table 1. Diurnal time-activity budget of Andean Geese on 3 September at Paucarcoto, Lake Junin.

Activity	Time spent at each activity Hours	Percent
Grazing	8.8	73.3
Standing	1.1	9.2
Sitting	0.8	6.6
Preening	0.7	5.4
Walking	0.4	3.5
Flying	0.1	1.1
Drinking	0.1	0.5
Swimming	–	0.2
Bathing	–	0.1
Agonistic behaviour	–	0.1
Total	12.0	100.0

Number of observations 6,462

Food intake

Inter-faecal periods had an average value of 359±158 second (n=15) for geese observed between 10:00 and 13:00 hours. Thirty faeces were collected and had the following dimensions and mass: 65±9 x 14±2 mm, a fresh mass of 9.9±2.8 g and dry mass of 1.42±0.38 g. The length of the grazing day was 10.5 hours (Figure 2) but one would not expect droppings to be produced in the first hour of grazing (Ebbinge *et al.* 1975). Thus 95 droppings would have been produced on the pastures and a further 25 may be deposited at the roost during the night (Ebbinge *et al.* 1975; Summers and Grieve 1982). The daily output of faecal material would therefore have been 170 g DM or 135 g OM (Table 2). The OM digestive efficiency was found to be 35% (Table 2) so the daily intake would have been 208 g OM herbage or 235 g DM. Examination of plant remains in faeces revealed that the diet was mainly the fleshy-leaved marsh plants that predominated on the pastures.

Discussion

Numbers and distribution

The waterfowl at Lake Junin have been surveyed before so that observations on the past population size and distribution are available. Dourojeanni *et al.* (1968)

Table 2. Organic matter content, calorific value and cell wall content of Andean Goose faeces and clipped herbage, and resulting estimate of digestive efficiency. (DM = dry matter, OM = organic matter).

Sample	% organic matter	Calorific value Kj/g DM	Kj/g OM	% cell wall content DM	OM	OM digestive efficiency
Faeces	79.3	16.4	20.7	26.8	33.8	35%
Herbage	88.5			19.5	22.0	

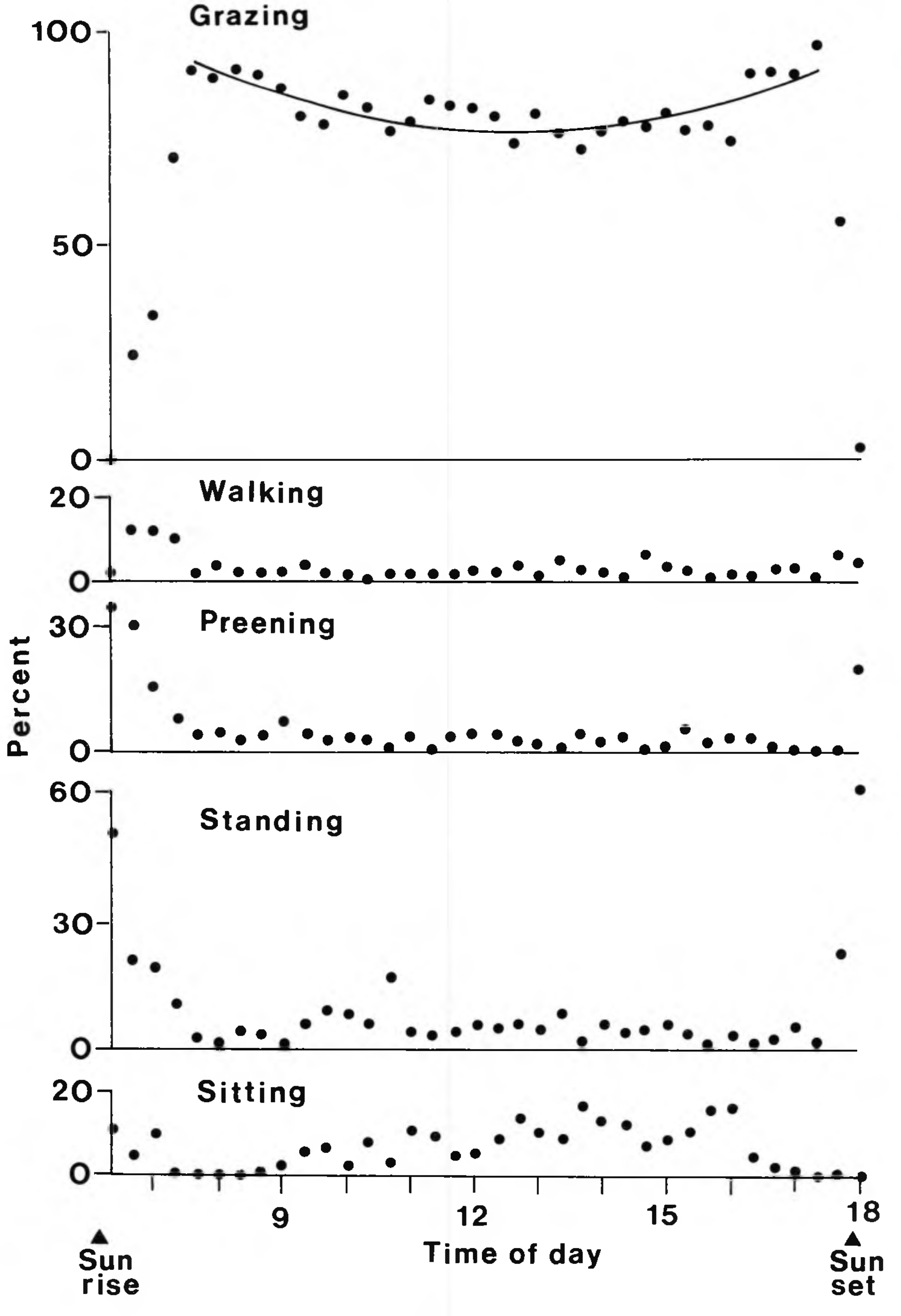

Figure 2. Diurnal changes in the percentage of Andean Geese carrying out different activities. The line for grazing is described by the quadratic equation,

$y = 0.66\ x^2 - 0.93\ x + 76.44;\ r^2 = 0.61;\ F(2,27) = 23.4,\ P<0.0001.$

Time is measured in hours before (–) and after (+) noon, for the period 07:40 to 17:20 hours.

counted 796 Andean Geese in June 1967 and noted that most occurred on the east side of the lake between Huayre and Tambo del Sol, whilst smaller numbers occurred between Pari and Ondores. In the present study none were seen in the former area, though it was more difficult to search this section adequately as the road is so far from the lake. In May 1979 Harris (pers. comm.) counted 240 east of Paucarcoto, where we found the main concentration, and 120 and 60 north and south of the road at Chacachimpa respectively (Figure 1). He estimated a total population of 500, whilst 1,000 were present in October 1979 (Harris 1981).

It is difficult to judge whether or not there has been any recent changes in goose numbers because the past counts have been carried out at different times of the year. All counts were during the non-breeding season when the largest numbers would be expected (few breed at Lake Junin). However, the length of the dry season which occurs through the winter could determine the number of geese which move from nearby small lakes and cause the increase at Lake Junin. The small ponds and lakes dry out whilst Lake Junin suffers only a reduction in water level.

Feeding ecology

The feeding behaviour of the Andean Goose in winter shows a number of similarities and differences to that of its congeners which occur further south. All spend the winter in temperatures which are only a few degrees above zero but in the high Andes the air is thin and solar radiation intense, whereas in Patagonia and the Falkland Islands the day-length is shorter in winter.

The Andean Goose spent 73% (8.8 hours) of the day grazing while Upland Geese and Ruddy-headed Geese *C. rubidiceps* spent 89% (8.9 hours) and 91% (9.1 hours) respectively, grazing on grass pastures in the Falkland Islands in August (Summers and Grieve 1982). Upland and Ruddy-headed Geese showed no delay in starting to graze at first light whilst the Andean Geese did not start grazing intensely until 1.3 hours after sunrise. This accounts partly for the lower percentage time spent grazing. The frost which covered the pastures may have delayed grazing until it was melted by the sun. The pattern of grazing was then similar to the Upland and Ruddy-headed Goose and all showed a mid-day drop in grazing intensity (Summers and Grieve 1982, Figure 2).

By examining periods of rest one can obtain an insight into whether Andean Geese maximise their use of available daylight for foraging, bearing in mind the limitations that may have been induced by frost. Andean Geese spent 6.6% (0.8 hours) of the day sitting (Table 1). These values are closer to the summer feeding activity of Upland and Ruddy-headed Geese which spent 8.8% (1.4 hours) and 8.3% (1.3 hours) of the day sitting, compared with winter when only 0.5% (0.05 hours) and 0.4% (0.04 hours) was spent sitting (Summers and Grieve 1982). Thus it would seem that Andean Geese do not need to graze at the same intensity as do Upland and Ruddy-headed Geese in their respective winter quarters.

The Andean Goose had a different diet (fleshy-leaved marsh plants) to the Upland Goose (principally the leaves of the grasses *Poa annua* and *P. pratensis)* and a lower rate of defaecation. However, their faeces were heavier (Table 3), and Andean Geese fed for a longer period so that their daily faecal output was similar to that of the Upland Goose, which is only slightly bigger. Also, since the digestive efficiencies were broadly similar, the gross intakes of herbage (expressed as a function of their metabolic mass) were similar (Table 3).

Relationships with man

The pastures around Lake Junin are important to local farmers for grazing sheep, cattle, horses and llamas. These animals were seen principally on drier pastures, perhaps because the marshes where the geese graze are too soft. Pigs, however, were seen feeding close to geese but they were rooting in muddy channels rather than grazing. It seems unlikely, therefore, that the geese would complete with stock. However, Dourojeanni *et al.* (1968) have reported geese grazing with sheep so perhaps during certain seasons or when the water level is different the pastures are shared.

Lake Junin became a National Reserve in 1975 and Andean Geese are no longer hunted for food, or sold in the markets of the surrounding towns. The larger number counted in this study compared with previous counts may be a reflection of the

Table 3. Estimates of faecal production, digestive efficiency and daily food intake for two species of sheldgoose in winter. (DM = dry matter, OM = organic matter).

	Andean Goose	Falkland Upland Goose*
Fresh body mass (g)	3185**	3350
Inter-faecal period (s)	359	241
Faecal mass (gDM)	1.42	1.12
Daily faecal output (gDM)	170	177
(gOM)	135	157
Cell-wall material in food (OM)	22.0%	24.7%
faeces (OM)	33.8%	39.8%
Digestive efficiency (OM)	35%	38%
Gross intake (gOM)	208	253
(gDM)	235	274
Intake per kg metabolic mass	100	112
(gDM/kg body mass $^{0.74}$)***		

* from Summers and Grieve (1982), and Summers unpubl.
** from Kolbe (1972)
*** from King and Farner (1961)

protection the geese now have, though the effects of the dry season may also have caused the increase.

Although a nature reserve, Lake Junin has no protection against pollution from the mines around Cerro de Pasco, 20 km from the lake, Tailing wastes are allowed to wash into the Rio San Juan which flows into the Upamayo Pond (Figure 1). Here a lot of the sludge has settled and now fills over half the pond. The contamination also filters through to Lake Junin and the shores nearest the Upamayo Pond are dark red with iron deposits. Binnie and Partners (1980) report that in the northern half of the lake the bottom now has deposits of flocculated iron. These have smothered the habitat of bottom living fish which form the diet of grebes and frogs. Very high concentrations of zinc and copper also occur in the Upamayo Pond, at levels above which coarse fish can tolerate. It is not known to what extent the pastures surrounding the lake are being affected, but heavy metals are being accumulated in the tissues of waterfowl (Binnie and Partners 1980).

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Summary

Observations were made on the non-breeding population of Andean Geese *Chloëphaga melanoptera* at Lake Junin, Perú from 1 to 4 September 1984. A total of 1,422 birds were counted on the marshy pastures east of Paucarcoto, and smaller numbers (465) on the west and south shores. The geese at Paucarcoto roosted on the lake shore and flew a short distance inland to graze. Grazing was at a low intensity for the first hour after sunrise; perhaps suppressed by the frost. However, grazing formed 73% of the diurnal time-activity budget and was most intense once the frost thawed in the morning, and in the second last hour before sunset. The diet was composed of fleshy-leaved marsh plants. An average interfaecal period of 6 minutes, a faecal mass of 1.42 g dry matter and organic matter digestive efficiency of 35% were used to estimate daily food intake at 208 g organic matter. Pollution by heavy metals from the nearby mines in destroying the natural environment of Lake Junin.

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