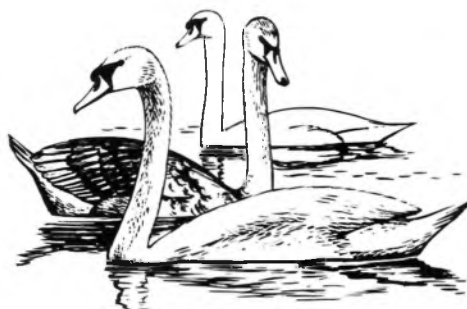


## The behaviour of a wintering flock of Mute Swans *Cygnus olor* in Southern Ireland



ELIZABETH M. KEANE  
and JOHN O'HALLORAN

*The behaviour of a wintering urban flock of Mute Swans was studied over a single winter 1990-91. Daily and weekly activity patterns were monitored. Swimming was the most common activity representing 55% of the time, with feeding and preening being 36% and 15% respectively. The most common feeding strategies were bread feeding, surface feeding and feeding with neck submerged.*

*Patterns of daily activity differed from those of other published studies, feeding increased significantly throughout the day, but the rate of feeding over the study period did not vary. When data for Saturdays and Sundays were omitted (the time of most bread provisioning), a different pattern of bread feeding by swans was observed.*

The Mute Swan *Cygnus olor* is the most familiar wildfowl species in Ireland. It is widespread, nesting throughout the country except where land exceeds 300 m (Hutchinson 1989). Little is known about its ecology, though recently some data have been reported for two Irish breeding flocks (Collins 1991, Smiddy & O'Halloran 1991). Population estimates vary between 5000-7000 individuals (Hutchinson 1979, Monval & Pirot 1989), and a large proportion is concentrated in urban inland and coastal waters as in the United Kingdom. Many flocks of non-breeding swans, congregating in such urban areas, are at least partially dependent on humans for food (Hutchinson 1979, Birkhead & Perrins 1986). Sears (1989) compared the feeding behaviour of Mute Swans in four habitats within the lowlands of the Thames valley and described their utilisation of bread. Other studies have concentrated on swans feeding in tidal, brackish and saltmarsh areas (Gillham 1956, Sparck 1958, Berglund *et al.* 1963, Mathiasson 1973), but commented little on the role of bread in the diet of Mute Swans. This present study set out to describe the diurnal and weekly activity/feeding pattern of a wintering flock of urban swans at Cork Lough, southern Ireland over a single winter.

### Study area

A single flock composed of immature, non-breeding and post breeding adults was studied at Cork Lough, a freshwater lake (6.1 ha in size), during the winter of 1990-91. There is an almost complete absence of aquatic vegetation (Kelly 1985). Mute Swans and other wildfowl species largely rely on feeding by man. In the centre of the lake there is a large island, where waterfowl roost and breed. The perimeter of the lake has grassland which is grazed by the waterfowl or mowed.

### Data collection

Data were collected using two methods: scan sampling and focal bird sampling after Sears (1989). Observations were made from dawn to dusk. 1) Scan sampling: observations were made on the flock every ten minutes throughout the day. The total number of birds and the proportion involved in a range of activities were recorded. 2) Focal bird sampling: uniquely ringed ('Darvic' rings) swans were observed continuously for a period of about 20 minutes. During this time, the type and duration of activity was recorded

and the proportion of observation time spent in each activity was calculated. All focal birds were chosen at random and were a sample of mixed ages and sexes.

the grass. 6) Walking: 7) Begging: (actively demanding food from people).

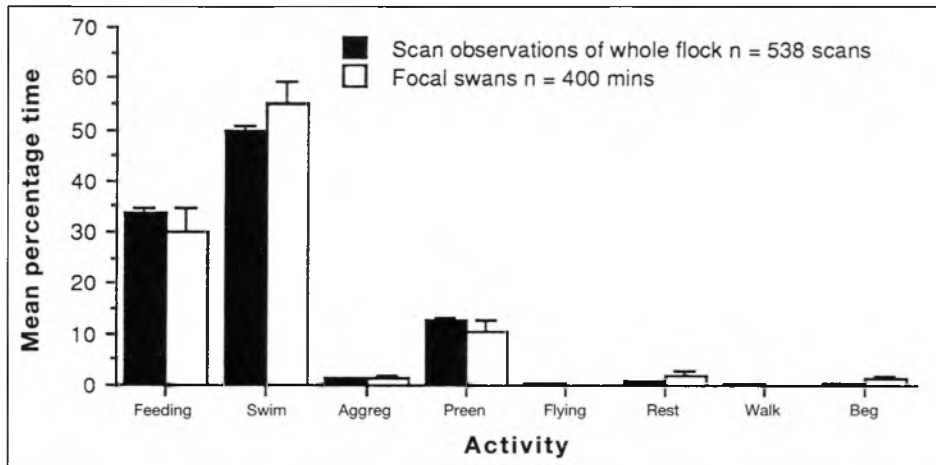
**Activity types**

Eight types of activity were distinguished: 1) Feeding: this could be subdivided into six categories: a) feeding on bread (all other feeding activities excluded bread), b) grazing, c) surface feeding, d) head submerged, e) neck submerged and f) upending.

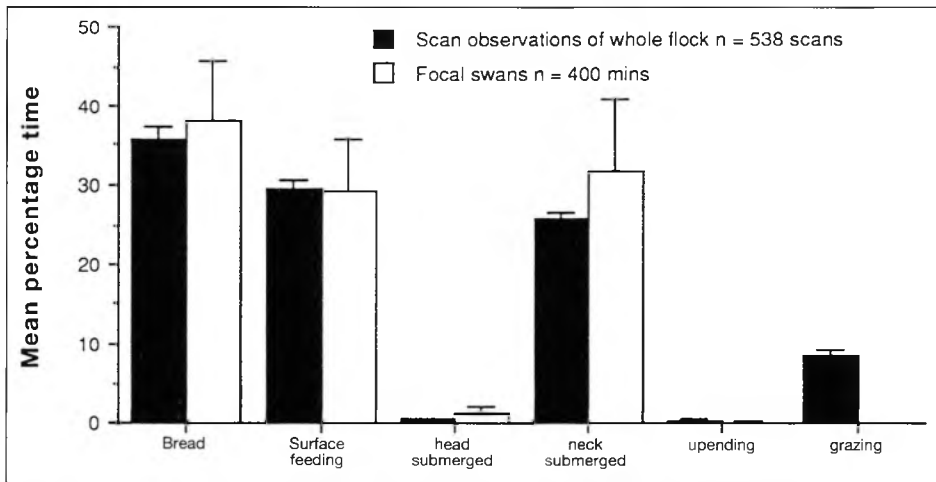
2) Swimming: 3) Preening: 4) Flying: 5) Resting: either on the water surface with neck under wing or in a similar posture on

The overall pattern of activity for the flock and focal birds was analysed to compare these two methods of sampling and to illustrate their activity and feeding strategy (see Figs 1 and 2). A separate time activity pattern was determined for each period of observation based on the proportion of the flock engaged in each activity at the time of the scan: a standard ethological protocol for time budget analysis Altmann (1974). For investigation of diurnal and weekly

**Analysis**



**Figure 1. Comparison of mean ( $\pm$  s.e.) activity budgets for flock and focal Mute Swans.** (538 scan observations of the whole flock, Focal birds 400 minutes observation, on 20 swans).



**Figure 2. Comparison of mean ( $\pm$ ) feeding activity budgets for flock and focal Mute Swans.** (538 scan observations of the whole flock, Focal birds 400 minutes observation, on 20 swans).

**Table 1. Details of the number of scan observations of a whole flock of Mute Swans over 41 days of the study (17 days in November; 15 days in December; and 9 days in January).**

	Hours since dawn										
	0	1	2	3	4	5	6	7	8	9	10
Scans ( <i>n</i> )	16	59	70	91	53	44	51	66	58	27	3

activity patterns, the proportions of time spent in each activity were calculated as a mean of all observation periods grouped over that time interval. This approach was used in order to reduce bias in the data collection and to ensure independence of the activity data (Bryant & Tatner 1988). Statistical analysis, involving analysis of variance (following arcsine transformation, after Snedecor & Cochran 1967) was carried out using Minitab (Pennsylvania State University) (Ryan, Joiner & Ryan 1985).

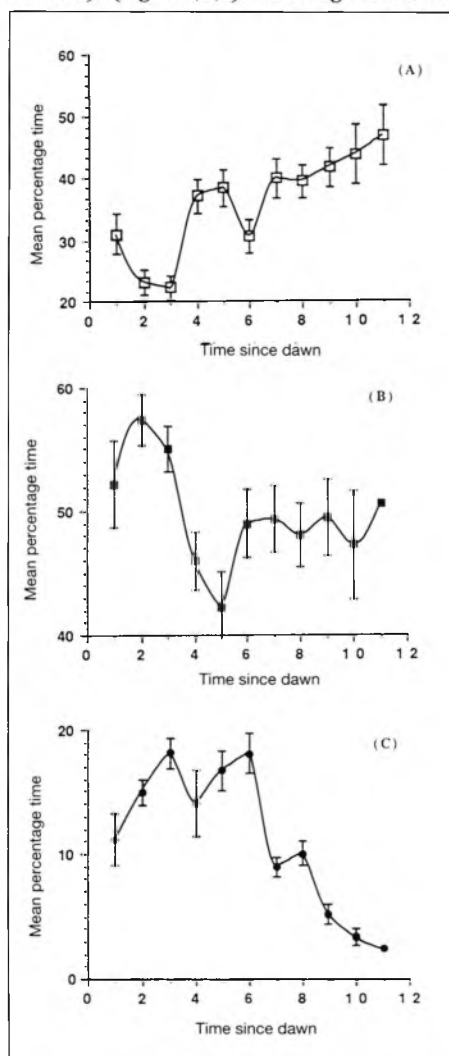
## Results

### Overall pattern

Data were collected on 41 different days, totalling 538 scans observations at different times of the day for the whole swan flock during the months November, December and January (Table 1). Twenty focal swans were observed for a total of 400 minutes during the three months. The mean number of swans present varied over the study period ( $F = 17.27$ ,  $df = 40$ ,  $P < 0.001$ ). Over the 90 hours of the study period, a significant increase in the number of swans occurred from 64 swans in November to 171 in January (correlation coefficient  $r = 0.708$ ,  $P < 0.001$ ,  $df = 39$ ). There was also a significant increase in the number of birds from dawn up to nine hours after dawn, when it then declined ( $r = 0.85$ ,  $P < 0.01$ ,  $df = 7$ ). There was no significant difference between focal or flock observation methods in the mean percentage time engaged in various behaviours (Fig. 1) or individual feeding strategies (Fig. 2), thus the detailed flock data only is presented. Swimming was the most common activity representing about 55% of the time, with feeding and preening being 36% and 15% respectively (Fig. 1). Bread feeding, surface feeding and feeding with neck submerged were the most common feeding strategies (Fig. 2).

### Diurnal activity patterns

The mean percentage time spent feeding, swimming and preening by Mute Swans varied during the day (feeding:  $F = 7.34$ ,  $df = 9$ ,  $P < 0.001$ ; swimming:  $F = 3.12$ ,  $df = 9$ ,  $P < 0.001$ ; preening:  $F = 20.02$ ,  $df = 9$ ,  $P < 0.001$ ) (Fig. 3a,b,c). Feeding increased



**Figure 3. Mean ( $\pm$  s.e.) proportion of time spent (A) total feeding (B) swimming (C) preening over the day by Mute Swans at Cork Lough, Ireland (538 scan observations of the whole flock).**

significantly between 7 and 12 hours after dawn ( $r = 0.845$ ,  $df = 9$ ,  $P < 0.01$ , Fig. 3a). Preening significantly decreased during the afternoon ( $r = -0.759$ ,  $df = 9$ ,  $P < 0.01$ ) (Fig. 3c).

Of the four feeding strategies observed, most time was spent feeding on bread provisioned by members of the public (Fig. 4a). The other main feeding activities were grazing, surface feeding and feeding with neck submerged (Fig. 4b,c,d). The pattern of grazing varied ( $F = 21.16$ ,  $df = 9$ ,  $P < 0.001$ ) with most grazing at dawn (Fig. 4b) but

#### Weekly variation

Though the study was only carried out over a three month period, it does give an accurate representation of Mute Swan activities at this site over a single winter. The mean amount of time the swans spent feeding did not vary significantly between weeks ( $F = 1.66$ ,  $df = 9$ , n.s.) (Fig. 5a), except in the case of time spent feeding on bread ( $F = 2.68$ ,  $df = 9$ ,  $P < 0.004$ ), which increased until January and then decreased dramatically. Within any one

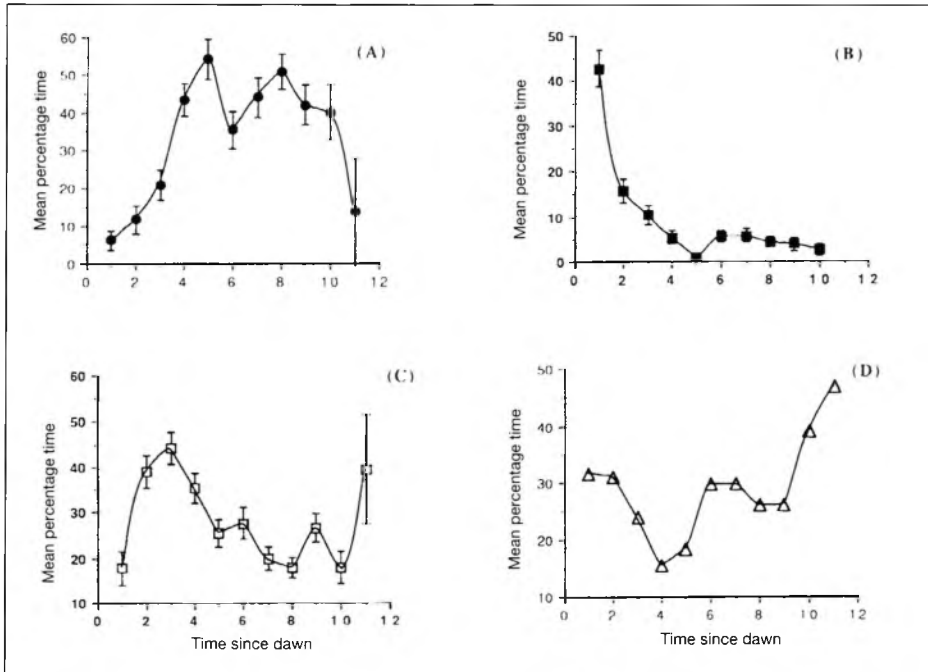


Figure 4. Mean ( $\pm$  s.e.) proportion of time spent (A) feeding on bread (B) grazing (C) surface feeding (D) neck submerged feeding over the day by Mute Swans at Cork Lough, Ireland (538 scan observations of the whole flock).

with a significant decrease ( $r = -0.701$ ,  $df = 8$ ,  $P < 0.05$ ) as the day progressed. The mean proportion of time spent surface feeding varied ( $F = 5.14$ ,  $df = 9$ ,  $P < 0.001$ ), with a peak during the early and later parts of the day (Fig. 4c) as did feeding with neck submerged ( $F = 5.14$ ,  $df = 9$ ,  $P < 0.001$ ) (Fig. 4d). Head submergence and upending only occurred infrequently, 0.51% and 0.36% of feeding time respectively. The swans spent little time (<5%) in other activities such as flying, resting, walking, aggression and begging.

week, a change in pattern emerged when Saturday and Sunday were omitted (the public are then most free to feed swans) (Fig. 6a). The time spent grazing and feeding with neck submerged varied during the winter ( $F = 5.50$ ,  $df = 9$ ,  $P < 0.001$ , Fig. 6b,  $F = 4.69$ ,  $df = 9$ ,  $P < 0.001$ , Fig. 6d), increasing at the end of January (Fig. 6b,d). Time spent surface feeding also varied between weeks ( $F = 4.48$ ,  $df = 9$ ,  $P < 0.001$ ) (Fig. 6c).

There was no variation in the mean amount of time spent swimming, preening ( $F = 1.94$ ,  $df = 9$ , n.s) or other activities over the three months of the study (Fig. 5b).

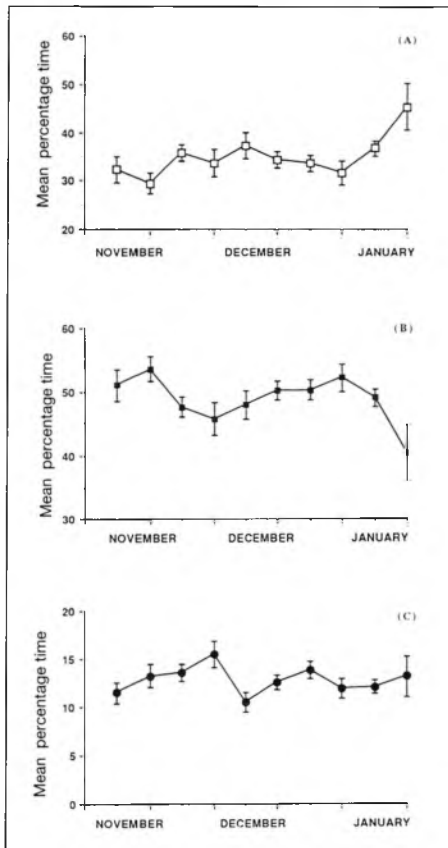


Figure 5. Mean ( $\pm$  s.e.) proportion of time spent (A) total feeding (B) swimming (C) preening by Mute Swans over the period of the study at Cork Lough, Ireland (538 scan observations of the whole flock).

### Discussion

There was no difference between the pattern of activity for focal swans and the flock birds at Cork Lough, over the duration of the study. The data presented for the flock birds are not only representative of this particular flock, but can also be used to represent the activity pattern of an individual swan at Cork Lough (Figs 1 and 2). The increase in the number of swans during the day can be partly explained by swans arriving in the morning from other areas to feed, and partly by birds emerging from their island roost. Ringing studies have shown that Mute Swans in the Cork area commute daily up to 15 km to feed at Cork Lough, but the numbers involved are small (O'Halloran unpubl.).

### Feeding patterns

The swans were found to spend an average of 36% of their day feeding. This accounts for a considerable proportion of their time, but swans need to have a large intake of food because of their poor digestive system (Birkhead & Perrins 1986). This compares with a value of only 22% in an urban area in the Thames valley (Sears 1989). However, these Thames swans were found to feed very little on the available aquatic vegetation when there was no provisioning of bread, which may account for the lower feeding rate. Moreover, Sears (1989) only observed swans between 10.00 and 13.00 hrs, which may have excluded any possible increase in feeding rates at other times of the day. At Caerlaverock in Scotland, Mute Swans spent 30% of their time feeding (Black & Rees 1984). Some of the above differences may be accounted for by the fact that there are many variables which determine the length of times swans spend feeding, e.g. availability of food, whether swans were preparing to breed or migrate. For example, Mute Swans in rural areas spent a much greater proportion of their day feeding than urban flocks (Sears 1989), which may be explained by the fact that urban swans are provided with most of their food. The Cork Lough swan flock is composed mostly of non-breeding adults or immature birds and the energetic requirements may be less than those for breeding swans.

Swans are almost exclusively diurnal feeders (Birkhead & Perrins 1986), and the amount of time spent feeding at Cork Lough increased significantly as the day progressed until dusk. In another study (Owen & Cadbury 1975), however, the feeding peaked about three hours after dawn. In our study the feeding level was in fact lowest at this time, as very few people came to provision bread. Many of the swans that initially had been grazing just after dawn (Fig. 4b) returned to the water, usually due to disturbance. The main feeding activity then switched to surface feeding (Fig. 4c). In the middle of the day, swans spent most of their time feeding on bread but towards dusk, bread feeding decreases and natural surface feeding and subsurface feeding increased. Explaining this feeding pattern is difficult because we are unable to discriminate whether the

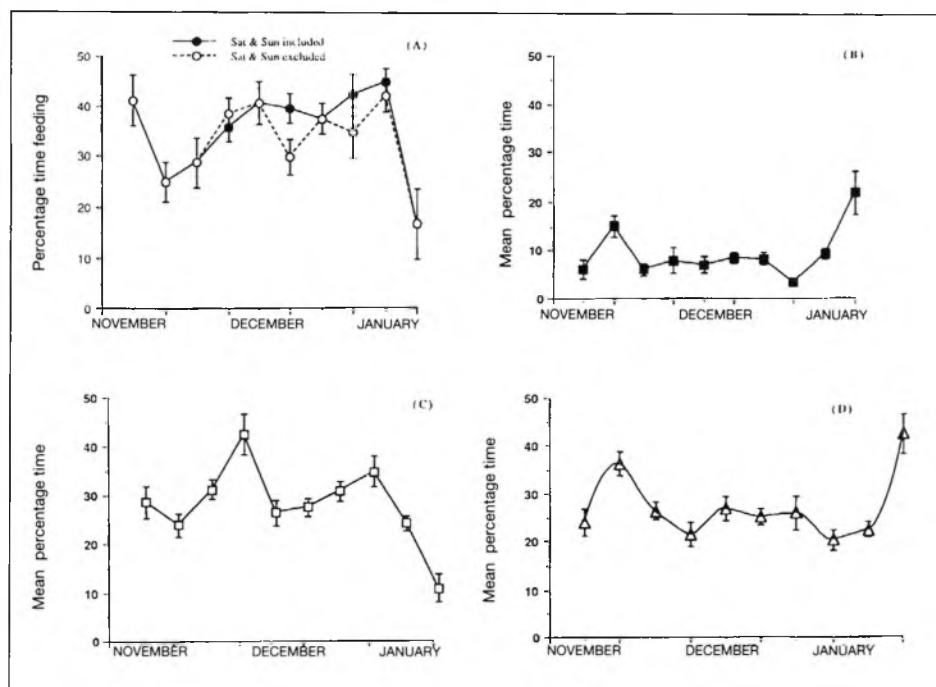


Figure 6. Mean ( $\pm$  s.e.) proportion of time spent (A) feeding on bread (B) grazing (C) surface feeding (D) neck submerged by Mute Swans over the period of the study at Cork Lough, Ireland (538 scan observations of the whole flock).

birds are actually feeding or foraging for grit. Mute Swans may have up to 94 g of grit present in their gizzards (O'Halloran unpubl.) and this must be replaced frequently. Though there is an increase in the natural feeding rate in the evening, whether this may be accounted for by searching for grit or feeding in the shallow waters of Cork Lough, is impossible to say.

The mean feeding level was relatively constant during the study period apart from an increase during the last week of January (Fig. 5a). Sears (1989) also found a seasonal pattern of feeding activity closely related to the seasonal supply of bread in the Thames urban flock, being lower during the winter months than at other times of the year.

#### Feeding on bread

On average about 36% of the swans' overall feeding time was spent feeding on bread. If the swans were grazing, they usually stopped when bread was supplied, suggesting that bread is the preferred food source. The amount of time the swans fed on bread remained relatively constant

until towards the end of January (Fig. 6a), when it decreased dramatically. A higher bread feeding rate occurred on Saturdays and Sundays when there was a continuous bread supply. Indeed, by the end of the day the swans had totally ceased to feed on the bread although it continued to be supplied. When the birds had completed feeding on bread they often turned their attentions to other activities such as preening. The consequences of bread feeding to swans (e.g. lower muscle reserves, inflation of habitat carrying capacity and increased risk of lead ingestion) have recently been reviewed by Sears (1989). At Cork Lough, lead poisoning and increased carrying capacity have been demonstrated (Kelly 1985, O'Halloran *et al.* 1988).

#### Grazing pattern

The Mute Swans grazed for about 10% of their feeding time at Cork Lough. Late winter and spring are usually accompanied by an increase in grazing on land as other natural food sources have died down (Birkhead & Perrins 1986). Black & Rees (1984) reported that Whooper and Bewick's

Swans spend more time grazing than Mute Swans. Grass is probably not the preferred food type of Mute Swans as they are inefficient at grazing on land, tending to drop a large portion of what they have cropped (Sears 1989). Also because they are unable to digest cellulose, they would need very large quantities to obtain sufficient nutrients exclusively from grass (Birkhead & Perrins 1986). Mute Swans seem to spend more time feeding on water than on land, thus reducing their vulnerability and avoiding awkward locomotion on land. In our study swans grazed most in the first hour after dawn (Fig. 4b), probably due to the lack of bread supply and/or reduced disturbance at that time.

The increase in grazing at the end of January seems to correlate with a decrease in bread feeding (Fig. 6b). In November, the swans only grazed early in the morning, but as winter progressed they extended their grazing to feed at other times of the day. No aquatic vegetation exists at Cork Lough, thus the increase in grazing is more likely to be related primarily to a reduction in bread feeding.

#### *Swimming*

As in other studies, swimming was found to be the primary activity (present study 45%; Black & Rees 1984, 45%). Sears (1989) did find a much lower swimming rate for the Mute Swans in the urban flock in the Thames valley, but this may be due to the length of the observation period. Swimming activity varied inversely with feeding and comfort activities during the day (Fig. 3a-c). Whooper Swans at Caerlaverock showed a similar inverse pattern (Black & Rees 1984), but in contrast they only spent

28% of their day swimming. The weekly variation in swimming was very little at Cork Lough until towards the end of January when it decreased as feeding activities increased considerably (Fig. 5a,b).

#### *Preening activity*

Mute Swans at Cork Lough spent less time preening (15%), than that of other studies. Sears (1989) found that in an urban area that swans preened for about 20% of the time between 11.00-13.00 hrs, also the time of the highest level of preening in our study. Black & Rees (1984) found the Mute Swans spent over 20% of their day in comfort activities. At Caerlaverock, where the Mute Swans co-existed with Whooper and Bewick's Swans, they had a lower feeding rate (30%) (Black & Rees 1984) compared to 36% at Cork Lough, which may account for the higher percentage of time spent preening.

#### **Conclusions**

This study illustrates that Mute Swans at Cork Lough rely on bread as a major source of food during the winter months. The unpredictability of this food source in time and space coupled with a higher incidence of lead poisoning (O'Halloran *et al.* 1988) may put this swan flock at risk. From the management point of view, it is clear that there are too many swans (60-140/6.1 ha) at Cork Lough, but from the wildlife conservation point of view, the conservation and continuous provision of bread is an essential feature of the success of this swan flock.

*We wish to acknowledge Dr Deirdre Murray, Patrick Smiddy, Clive Hutchinson and Drs Paul Giller and Jane Sears, and the referees for comments on an earlier draft of this manuscript.*

#### **References**

- Altman, J. 1974. Observational study of behaviour, sampling methods. *Behaviour* 48:227-268.
- Berglund, B.E., Curry-Lindahl, K., Luther, H., Olsson, V., Rodhe, W. & Sellergberg, G. 1963. Ecological studies of the Mute Swan (*Cygnus olor*), in South eastern Sweden. *Acta vertebratica* 2:167-288.
- Birkhead, M.E. & Perrins, C. 1986. *The Mute Swan*. London, Croom Helm.
- Black, J.M. & Rees, E.C. 1984. The structure and behaviour of the Whooper Swan population wintering at Caerlaverock, Dumfries and Galloway, Scotland: an introductory study. *Wildfowl* 35:21-36.

- Bryant, D.M. & Tatner, P. 1988. Energetics of the annual cycle of Dipper, *Cinclus cinclus*. *Ibis* 130:17-38.
- Collins, R. 1991. Breeding performance of an Irish Mute Swan Population. In: J. Sears & P.J. Bacon (Eds.), Proceedings of 3rd Int. Swan Symposium, Oxford. *Wildfowl Supplement* No. 1. pp.143-149.
- Gillham, M.E. 1956. Feeding habits and seasonal movements of Mute Swans on two South Devon estuaries. *Bird Study* 3:205-212.
- Hutchinson, C.D. 1979. *Irelands' wetlands and their birds*. Irish Wildbird Conservancy, Dublin.
- Hutchinson, C.D. 1989. *Birds in Ireland*. Poyser, Calton.
- Kelly, T.C. 1985. The status of the Cork Lough. Unpublished report of Department of Zoology, UCC Ireland.
- Mathiasson, S. 1973. A moulting population of non-breeding Mute Swans with special reference to flight-feather moult, feeding ecology and habitat selection. *Wildfowl* 24:43-53.
- Monval, J-Y. & Pirot, J-Y. 1989. Results of the IWRB International Waterfowl Census 1967-1986. *IWRB Special Publication No. 8*.
- O'Halloran, J., Myers, A.A. & Duggan, P.F. 1988. Lead poisoning in swans and sources of contamination in Ireland. *J. Zool. London* 216:211-233.
- Owen, M. & Cadbury, C.J. 1975. Ecology and mortality of swans at the Ouse Washes, England. *Wildfowl* 26:31-42.
- Ryan, B.F., Joiner, B.L. & Ryan, T.A. 1985. *Minitab Handbook* 2nd edition. Duxbury Press, Boston.
- Sears, J. 1989. Feeding activity and body condition of Mute Swans *Cygnus olor* in rural and urban areas of a lowland river system. *Wildfowl* 40:88-98.
- Smiddy, P. & O'Halloran, J. 1991. The breeding biology of Mute Swans *Cygnus olor* in southeast Cork, Ireland. *Wildfowl* 42:12-16.
- Snedecor, G.W. & Cochran, W.G. 1967. *Statistical Methods*. Ames, Iowa. Iowa State University Press.
- Sparck, R. 1958. An investigation of the food of swans and ducks in Denmark. *Trans. Cong. Int. Union Game Biol.* 3:45-47.

**Elizabeth M. Keane and John O'Halloran\***, Department of Zoology, University College, Cork, Ireland.

\*To whom correspondence should be addressed.