# Daily time and energy budgets of Whooper Swans *Cygnus cygnus* and Bewick's Swans *Cygnus bewickii* in the breeding season

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*Both Bewick's and Whooper Swans require little energy during incubation relative to birds in temperate latitutes (1.8 and 1.9*BM, as opposed to 2.5*BM). Whooper Swans expend considerable energy on flying. Their behaviour assists in maintaining them at low energy levels appropriate to the short cold summer and low calorific foods found in their sub-arctic breeding areas.*

The relatively low summer temperature and availability of food has a significant influence on the activities of waterfowl in the sub-arctic. Adaptation to these conditions may be expressed in a change in the level of metabolism and reduced activities. At present there is little data on the energy budgets of birds with different levels of adaptation to sub-arctic conditions, especially with *Anseriformes*. This short paper briefly reports the main behaviours and associated energy expenditures of two species of swan, Whooper Swan *Cygnus cygnus* and Bewick's Swan *Cygnus bewickii*, during the breeding season. The study was carried out in the sub-zone of the moss-and-sedge tundras on Yugor Peninsula in the northern forest-tundra of the Malozemelskaya Tundra in the European north-east of the USSR.

The main task of the study was to establish the distribution of the daily time and energy budgets of these two similar swan species and assess how such differences in energy expenditure were related to food resources or behavioural differences.

## Methods

The data were collected in June 1984 and June 1986 in the basin of the River Lymbadayakha in the Yugor Peninsula and in the Lake Urdyuzhskoye region of the Malozemelskaya Tundra. In the middle of the incubation period two daily time budgets (DTBs) were obtained for Bewick's Swans and two for Whooper Swans using the individual chronometry method.

The DTBs were converted into Daily Energy Budgets (DEBs) by using appropriate activity coefficients (Dolnik 1980, 1982). The amount of basal metabolism (BM) and specific heat emission (h) were calculated using the Kendeigh formula (Kendeigh *et al.* 1977). The average body masses of Bewick's Swans and Whooper Swans were taken as 5.5 and 8.5 kg respectively (Buturlin 1935). Energy expended on incubation was assumed to be one third of BM over the appropriate period in the case of uninterrupted incubation. During this short study it was not possible to record changes in body mass or the calorific equivalent. Nor was it possible to study special types of behaviour which save, or expend extra, energy.

## Results and discussion

The distribution of activities in the DTBs differs considerably between Bewick's Swans and Whooper Swans in the breeding period, (Table 1). Whooper Swans spend significantly more time sleeping and flying and less time feeding and incubating than do Bewick's Swans. Approximately equal amounts of time are spent by both species on resting, swimming and comfort behaviour (preening, etc).

In contrast to Bewick's Swans, Whooper Swans feeds almost exclusively in the shallows, usually in the same part of the lake and only 2 to 2.5 km from the nest. The feeding sites of Bewick's Swans were much more diverse, not strongly localised and close to the nest.

The time spent at the nest also differs considerably between the species. The male Bewick's Swan changes places with the female when she is feeding, but in Whooper Swans only the female ever incubates the clutch. During

**Table 1. Daily time budgets in Bewick's Swans and Whooper Swans in the breeding period (in hours).**

| Type of activity | Value of activity | Bewick's Swans male | Bewick's Swans female | Whooper Swans male | Whooper Swans female |
|---|---|---|---|---|---|
| 1 Presence at nest: | | 1.54 | 22.38 | — | 20.3 |
| sleep | 1.0 BM | — | 3.0 | — | 5.0 |
| daytime rest | 1.12 BM | — | 0.5 | — | 0.75 |
| incubation | 1.3 BM | 1.54 | 18.48 | — | 14.15 |
| comfort behaviour | 1.3 BM | — | 0.4 | — | 0.4 |
| 2 Absence from nest: | | 22.46 | 1.62 | 24.0 | 3.7 |
| sleep | 1.0 BM | 2.5 | — | 4.0 | — |
| daytime rest | 1.12 BM | 1.55 | — | 1.6 | — |
| guarding | 1.3 BM | 2.03 | — | 4.8 | 0.82 |
| comfort behaviour | 1.3 BM | 0.53 | — | 0.75 | 0.25 |
| social behaviour | 1.3 BM | 0.53 | 0.01 | 0.2 | 0.06 |
| feeding on shore | 1.3 BM | 2.9 | 0.33 | 0.25 | 0.25 |
| walking | 1.6 BM | 0.55 | 0.33 | 0.2 | 0.2 |
| swimming and feeding on water | 1.6 BM | 12.09 | 1.2 | 11.2 | 1.8 |
| fighting | 6.0 BM | 0.01 | 0.04 | — | — |
| taking off | 16.0 BM | 0.01 | 0.005 | 0.1 | 0.05 |
| horizontal flight | 12.0 BM | 0.2 | 0.01 | 0.7 | 0.2 |
| gliding | 1.6 BM | 0.01 | 0.005 | 0.1 | 0.05 |

NB—incubation also includes such types of behaviour as guarding, looking around, adding to the nest and changing places on the nest.

our observations Bewick's Swan clutches were without a sitting bird for only a few trivial periods (5 to 7 minutes) whereas Whooper Swan clutches of could be unattended for more than three hours.

On the whole the distribution of the DEBs is similar to that of the DTBs. A significant amount of total energy was expended by both species on low-rate activities, such as resting, walking and feeding. Whooper Swans expended a considerable proportion of energy in flying. The total DEB of Whooper Swans is higher than for Bewick's Swans (Table 2); but both are lower than the assumed level of DEB for birds in temperate latitudes, which is usually taken as 2.5*BM (Dolnik & Ilyina 1982).

It is apparently not energetically advantageous for Whooper Swans to feed on diffusely distributed food over large areas. They need a large concentration of food per unit area. It seems possible that the limited number of such areas in the tundra (often disconnected from each other) might determine the distribution and dispersion of Whooper Swans. If Whooper Swans must expend a great deal of energy on flying they may have to reduce time spent feeding and increase time spent resting in order to maintain their energy balance. This is consistent with the Whooper Swan being stressed at the limit of its range.

**Table 2. Energy expenditure on activity, thermo-regulation and DEB in Bewick's Swans and Whooper Swans**

| Species | Sex | BM kJ/day | DEB kJ/day | Average temp (°C) | Expenditure on thermo-regulation kJ/day | DEB kJ/day | DEB/ BM |
|---|---|---|---|---|---|---|---|
| Bewick's Swan | male | 1255.2 | 1953.4 | 8 | 285.1 | 2238.5 | 1.78 |
| | female | 1255.2 | 2008.7 | 8 | 288.0 | 2296.1 | 1.83 |
| Whooper Swan | male | 1723.2 | 3014.8 | 1 | 412.0 | 3426.8 | 1.99 |
| | female | 1723.2 | 2859.8 | 1 | 424.9 | 3284.7 | 1.91 |

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