# Diurnal behaviour of wintering Wigeon *Anas penelope* at Lac des Oiseaux, northeast Algeria

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Over a period of four years, the diurnal behaviour of Wigeon *Anas penelope* was monitored at Lac des Oiseaux, a shallow freshwater lake, part of the Numidian wetland complex located in northeast Algeria. Wigeon arrive around late October and overwinter for 5-6 months, with numbers fluctuating between 200 and 3,000 birds. They occupy the central area of the lake and northwestern parts dominated by Bulrush *Scirpus lacustris* and Sea Club-rush *S. maritimus*, far from any human disturbance. Results show a seasonal change in behaviour throughout the study period and highlight the fact that feeding formed an important part of the birds' diurnal activities at Lac des Oiseaux, which is used both as a feeding area and a roost. These results differ from data obtained in parts of Europe, where feeding is mainly a nocturnal activity. Possible factors influencing the geographic variation in the diurnal behaviour of Wigeon are discussed.

**Key Words: Anatidae, dabbling ducks, wetlands, time budget, wintering ecology, conservation, North Africa**

The ecology of Wigeon *Anas penelope* has been studied intensively in Europe (Owen 1973; Campredon 1982; Pirot *et al.* 1984; Allouche *et al.* 1989; Mayhew & Houston 1989; Tamisier & Pradel; 1992; Brunckhorst & Rösner; 1998; Mathers *et al.* 2000) but has received little attention in North Africa, where local wetlands are under increasing anthropogenic pressure (Bredin *et al.* 1986; Samraoui *et al.* 1992; Tamisier & Boudouresque 1994). A study of the behaviour of Wigeon, one of the most abundant waterfowl in the

region, is helpful in order to understand the geographic variation in the wintering strategies of ducks and to identify key ecological requirements. Several studies have shown that Wigeon are quite adaptable and are able to display a tremendous plasticity of behaviour to match changing environmental conditions within a specific habitat (Owen & Williams 1976; von Känel 1981). The lack of data on local populations has considerably hampered conservation efforts, and, by exploring the ecology of Wigeon, this paper aims to fill some gaps in scientists' knowledge of the use of local wetlands by waterfowl.

## Methods

Data were collected at Lac des Oiseaux (northeastern Algeria), a shallow freshwater lake of 75ha dominated by Narrow-leaf Cattail *Typha angustifolia* and Bulrush *Scirpus lacustris* (**Figure 1**). The study site is part of the eastern Numidian wetland complex, which holds three Ramsar sites, Lac des Oiseaux, Lac Tonga and Lac Oubeïra, as well as a variety of marshes, dune slacks and seasonal ponds. Lac Tonga and Lac Oubeïra are located within the El Kala National Park (Stevenson *et al.* 1988; Samraoui & Bélair 1998). The western Numidian wetland complex includes Ramsar sites such as Lac Fetzara and the Guerbes-Senhadja wetlands (Samraoui & Bélair 1997). During the study period the lake had not yet become a protected area but hunting was rare, in contrast to the neighbouring Mekhada marsh, where hunting pressure was relatively strong.

Weekly observations were made from October 1996 to October 2000 through a 20x60 telescope and a pair of 10x50 binoculars. Individual counts were carried out whenever the total number of Wigeon was fewer than 200. When this number was exceeded, an estimate of the population size was achieved by dividing the flock into small equal parts and through extrapolation. The spatial distribution was recorded on a map and the birds' time budget (October-April) was monitored from 0700h to 0930h and from 12 noon to 1430h. These two periods were assumed to be representative of a full day, although Campredon (1981) has shown that Wigeon may, at times, display an uneven pattern of diurnal behaviour. A randomly selected focal duck (Altmann 1974) was followed for 10 minutes and its behaviour divided arbitrarily into five activities: feeding, swimming, preening, sleeping and flying. Additional observations were carried out at dawn and dusk to record the duck's movements between Lac des Oiseaux and any other adjacent wetland. A data matrix (42 weeks/5 activities) was assembled and analysed using multivariate statistical analysis with the ADE-4 package (Thioulouse *et al.* 1997).

To confirm observations made at Lac des Oiseaux, in February 2002 the time budget of Wigeon at two other sites, the Mekhada, a seasonal brackish marsh of 15,000ha, and Lac Tonga,

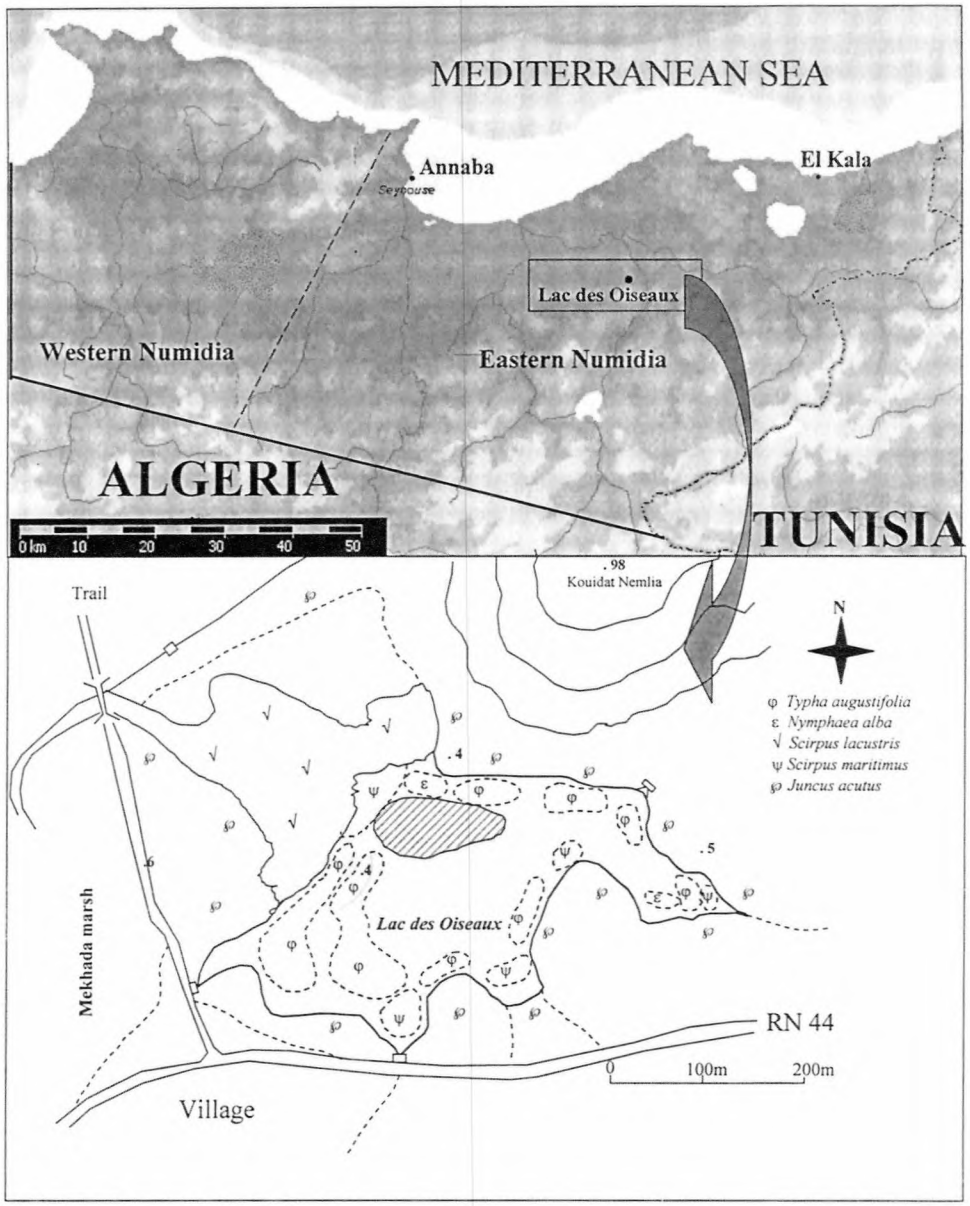


**Figure 1.** Maps of Lac des Oiseaux, northeast Algeria, showing the location of wintering Wigeon during 1996-1999.

a shallow freshwater lake of 2,400ha was monitored using scan sampling (Altmann 1974). A total of 45 hours were devoted to these latter observations at each site. Hunting was relatively frequent throughout the study period at both sites.

## Results

Wigeon arrived at the end of October, several weeks after the first wintering Teal *A. crecca* (Houhamdi & Samraoui 2001). At first the number of birds fluctuated, a probable indication of transient birds on their way further south, then the population size increased and the peak was reached during January (**Figure 2**). Thereafter, the number decreased sharply and stabilised for several weeks before gradually dwindling off with the birds' departure in mid-March. During the study period, Wigeon occupied the lake for 6-7 months, with an average population size of 500 and peaks of around 3,000 birds.

Wigeon displayed a relatively stable spatial structure within the lake, concentrating in the centre and close to northwestern parts dominated by bulrush *S. lacustris* and scattered patches of bulrush *S. maritimus*; two other species, Eurasian Water Milfoil *Myriophyllum spicatum* and Fennel Pondweed *Potamogeton pectinatus*, also abound there.

Monitoring the time budget during the four year period (1996-2000), a total of 209 hours, indicated that feeding was

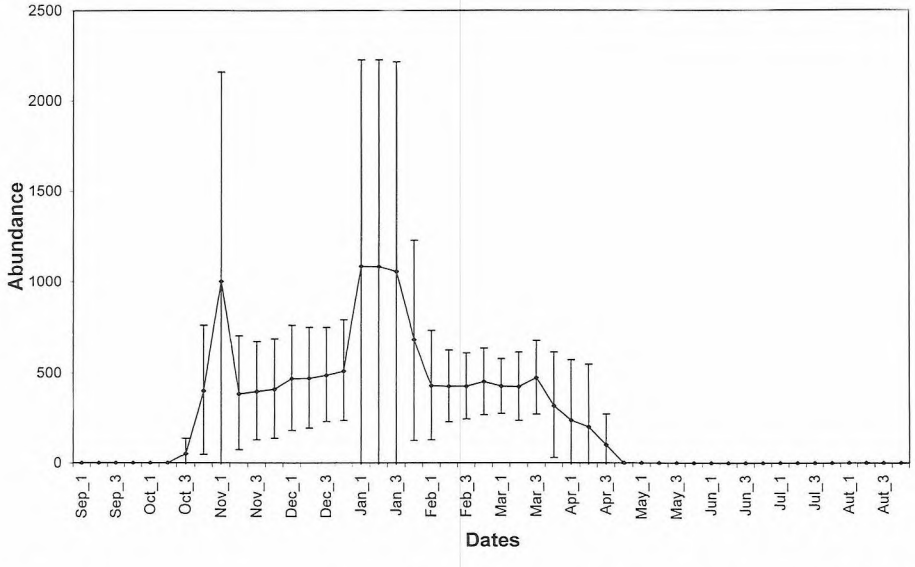


**Figure 2.** Weekly counts of Wigeon at Lac des Oiseaux, northeast Algeria, for four periods: 1996-1999. Vertical lines are standard errors.

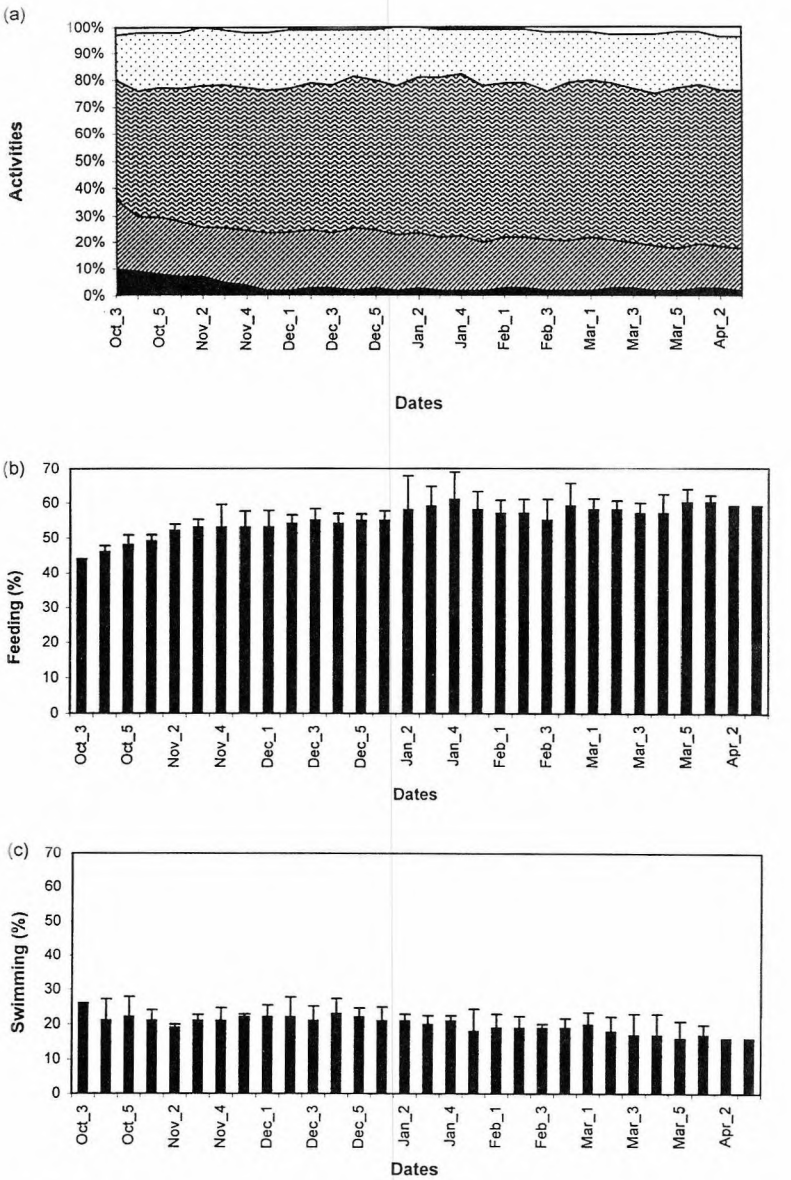


**Figure 3.** (a) Percentage of time allocated by Wigeon at Lac des Oiseaux, northeast Algeria, to diurnal activities ( sleeping; swimming; feeding; preening and flying). Data have been averaged over four wintering periods. (b) Percentage of time allocated by Wigeon to diurnal feeding at Lac des Oiseaux for four periods: 1996-1999. Vertical lines are standard errors. (c) Percentage of time allocated by Wigeon to diurnal swimming at Lac des Oiseaux for four periods: 1996-1999. Vertical lines are standard errors.

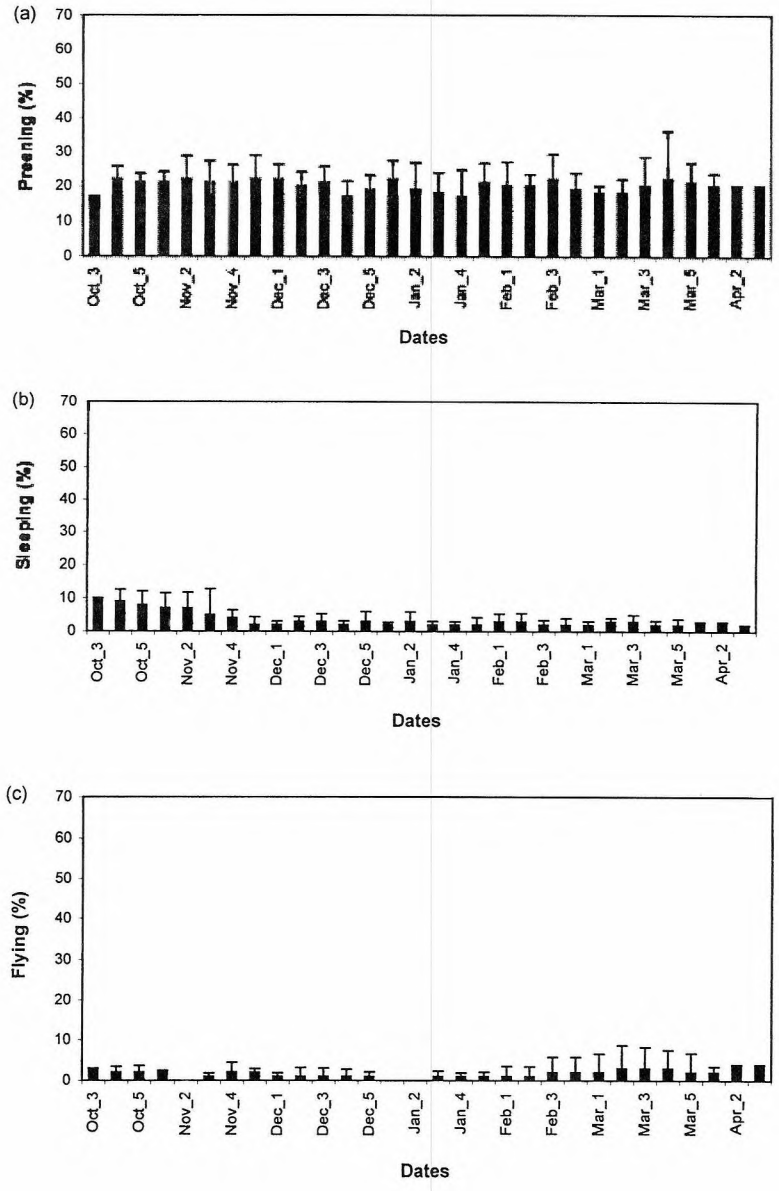


**Figure 4.** (a) Percentage of time allocated by Wigeon to diurnal preening at Lac des Oiseaux, northeast Algeria, for four periods: 1996-1999. Vertical lines are standard errors. (b) Percentage of time allocated by Wigeon to diurnal sleeping at Lac des Oiseaux for four periods: 1996-1999. Vertical lines are standard errors. (c) Percentage of time allocated by Wigeon to diurnal flying at Lac des Oiseaux for four periods: 1996-1999. Vertical lines are standard errors.

the main activity (55% of time spent), followed by swimming and preening (20%), sleeping (3%) and flying (2%) (**Figures 3-4**). In sharp contrast to their counterparts that overwinter in the Camargue, Wigeon at Lac des Oiseaux spent, overall, a negligible part of their time in sleep and fed actively by day.

Time devoted to feeding increased steadily throughout the wintering period, from 45% upon arrival to nearly 60% prior to the return flight. Preening was an important activity: the time allocated to preening, carried out mostly in the morning, remained stable throughout the study period at around 20%. Swimming represented, upon arrival, 27% of diurnal activity before falling to around 18% for the rest of the wintering period. Swimming was generally associated with feeding, and 85% of the birds were recorded feeding while swimming whereas 15% were observed to feed on the northern and northwestern banks of the lake. Time allocated to sleep displayed a progressive decline, from 10% at the start of the wintering period to 2-3% prior to the return of the Wigeon to their breeding grounds. This latter activity was clearly confined to the first part of the day. Flight, infrequently recorded and with a peak of 4% during the four year period, was manifest at the end of the wintering period and was generally provoked by the presence of children. Wigeon were not easily disturbed by marauding Marsh Harrier *Circus aeruginosus* and reacted only by flocking in the centre of the lake.

Preliminary data recorded at the Mekhada marsh and Lac Tonga seem to confirm results obtained at Lac des Oiseaux. At both sites, feeding dominated other activities, with swimming and preening being more frequent than sleeping and flying (**Figure 5**).

The factorial plane of the first two axes of the correspondence analysis (88% of inertia) is sufficient to reveal the structure in the data by outlining the progressive seasonal change in behaviour (**Figure 6a**). The first axis (63% of inertia), which can be deemed to represent the 'energy axis' (**Figure 6b**), shows the clear opposition between feeding (actively gaining energy) and sleeping (keeping energy expenditure at a minimum) whereas the second axis (25% of inertia) highlights the monthly gradient (December-April) that singles out comfort (and possibly courtship) activities from flying, which is more pronounced prior to the Wigeon's departure from the study site.

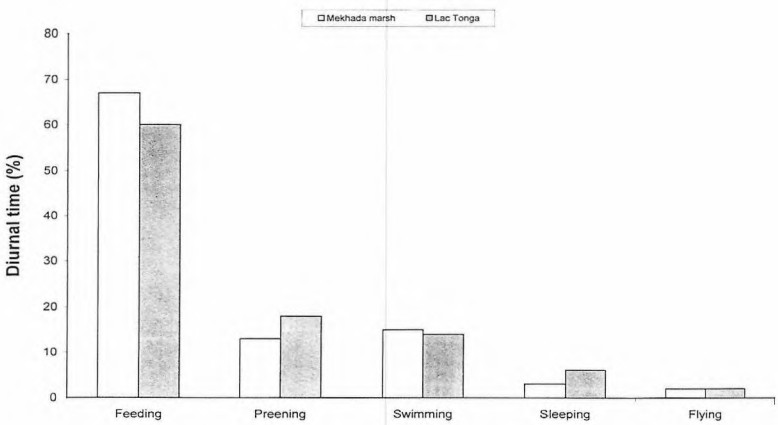


**Figure 5**. Percentage of time spent by Wigeon in diurnal activities at the Mekhada marsh and Lac Tonga, northeast Algeria.

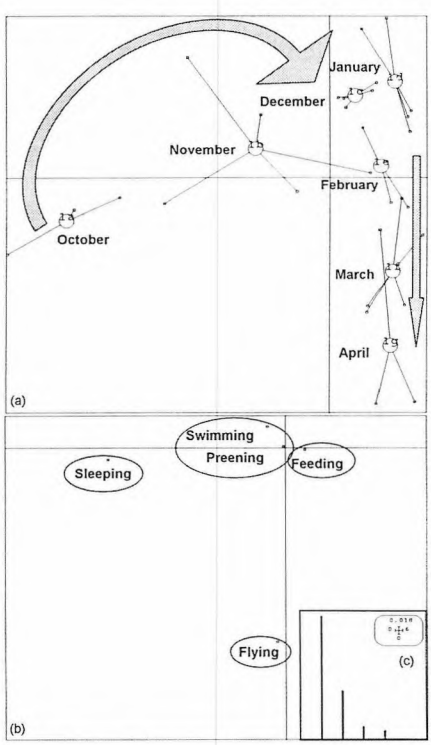


**Figure 6**. Plot of factorial plane 1x2 of correspondence analysis of the diurnal behaviour of Wigeon in northeast Algeria: a) ordination of dates with the circles representing the weighted average of sampling weeks (small squares); b) ordination of diurnal activities; c) histogram of eigenvalues.

## Discussion

A sizable proportion of Wigeon winter regularly in Numidia (Atkinson-Willes 1974), where up to 100,000 have been counted. Counts in recent years have confirmed that the region is an important wintering and staging area for Wigeon (Isenmann & Moali 2000). Good estimates of the total Wigeon population wintering in Numidia are unavailable, but the birds at Lac des Oiseaux, Lac Tonga and the Mekhada marsh probably amount to a sizeable fraction of the total count (Lac Fetzara is the only other major site in the region).

The late arrival of Wigeon in Numidia is similar to that recorded in the Camargue, but some uncertainties surround the status of Wigeon that winter in Algeria and Tunisia, which may belong to a population distinct from that wintering in the Camargue, whose reproductive grounds are in Siberia (Tamisier & Dehorter 1999).

Unfortunately, the present study did not include courtship activities and focused only on diurnal behaviour; however, Wigeon were shown not to devote a sizable part of their diurnal time to courtship (Tamisier & Dehorter 1999). To overcome the other limitations of the present study, nocturnal data are needed to assess the overall behaviour of Wigeon (Baldassarre *et al.* 1988).

The wintering strategy of Wigeon has been divided into three distinct phases, with October and November devoted largely to recovery through intensive feeding and preening. December and January see a substantial increase in the time allocated to sleeping and swimming, whereas in February and March the birds' activities are dominated by sleeping and, once more, feeding (Campredon 1982; Tamisier *et al.* 1995). Another feature recorded in the Camargue, southern France, is that feeding grounds are distinct from roosts, making up 'functional units' (Tamisier 1985).

The pattern of behaviour and use of wetlands observed in Numidia are not fully consistent with the Camargue model but are similar to those recorded at Lac Ichkeul, Tunisia (Bredin *et al.* 1986), which Wigeon exploit as both a diurnal feeding ground and a roost. Although these differences may be heightened for methodological reasons (scan vs focus methods, sample size, diurnal and nocturnal observations vs diurnal data), the present study points towards distinct diurnal uses of wetlands by Wigeon on each side of the Mediterranean. How can the discrepancies between these patterns be accounted for?

It is worth noting that studies of time budgets of Wigeon wintering in Europe have revealed a wide variation in the circadian pattern of feeding and sleeping (Campredon 1982). The spatio-temporal distribution observed in the Camargue and elsewhere has been attributed to a fixed life trait rather than a recent adaptation to hunting disturbance (Dehorter & Tamisier 1998). Two

other reasons, disturbance and visual selection of food, have been put forward to explain the geographical discrepancy in behaviour. Disturbance may indeed constrain ducks to seek safety in numbers during the day in roosts, whereas they may disperse more safely and feed by night when predation and hunting pressures are low.

Disturbance by predators, including humans, undoubtedly plays an important role in the selection of feeding sites (Owen & Williams 1976). In England, feeding is diurnal in protected areas and nocturnal in habitats experiencing different intensities of disturbance, whereas both in England and France, feeding in mudflats is influenced by the timing of tides (Owen & Thomas 1979; von Kanel 1981; Campredon 1982; Mayhew 1988). It is possible that the diurnal disturbance encountered by Wigeon in Numidia is below a specific threshold. Data on this aspect are needed urgently as human encroachment is ever-increasing and Lac des Oiseaux might well become unsuitable for wintering birds.

The second constraint, manifested in the need to select food visually in a heterogeneous environment, is linked to the Wigeon's diet, which includes short grass swards (Owen 1973; Mayhew & Houston 1989). In the Camargue, the diet of Wigeon has been found to be composed, to a sizable extent, of Ditchgrass *Ruppia cirrhosa*, Dwarf Eelgrass *Zostera noltii*, Fennel Pondweed, Lesser Pondweed *P. pusillus*, Eurasian Water Milfoil, Buttercup of Baudot *Ranunculus baudotii* and glasswort *Salicornia* sp. (Campredon 1984). Wigeon are also able to incorporate seeds and animal material in their diet (Cramp & Simmons 1977; Danell & Sjöberg 1982; Jacobsen 1991).

The Wigeon's small body size and herbivorous diet are constraints that are met by its high food intake and relatively longer feeding bouts (Campredon 1982; Mayhew 1988; Mayhew & Houston 1993). In order to meet its heavy energy requirements, the Wigeon's feeding plasticity has evolved to allow it to graze around the clock (Mayhew 1988) and in a great variety of habitats, ranging from freshwater lakes to intertidal salt marshes. This pattern of behaviour may be particularly important at latitudes where energy requirements may be higher due to lower winter temperatures. The total feeding time per day in Numidia appears to be markedly shorter than that found elsewhere (12-16 hours), but further investigations of nocturnal behaviour of Wigeon are needed before factors underlying such differences can be addressed safely.

The wide geographic difference in the pattern of feeding and use of wetlands need not be induced by a single factor, and it seems likely that it may reflect the interaction of hydrology, productivity, disturbance and other processes difficult to identify by observation alone. Clearly, more detailed studies are needed to unravel the full range of behaviour displayed by Wigeon in North Africa, and this effort should

include the use of more observation sites that hold larger numbers of birds.

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