ACTIVITIES AND FOOD RESOURCES OF WINTERING TEAL (*ANAS CRECCA*) IN A DIURNAL FEEDING SITE: A CASE STUDY IN WESTERN FRANCE

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RÉSUMÉ

En hiver, les canards de surface utilisent en général deux types d'habitats distincts au cours des 24 heures, les oiseaux se reposant en grand nombre la journée sur quelques plans d'eau de grande taille, et se dispersant la nuit pour s'alimenter sur de nombreuses zones plus petites. Dans certains cas, les canards peuvent toutefois utiliser le même plan d'eau le jour et la nuit. Cette étude a été menée sur un plan d'eau de moins d'un hectare, utilisé par des Sarcelles d'hiver (*Anas crecca*) à la fois le jour et la nuit au début de l'hiver. Le nombre de canards n'était pas lié à l'abondance des ressources alimentaires, aux niveaux d'eau ou à la surface du bassin. Leur budget-temps n'était pas différent entre le jour et la nuit, l'alimentation étant toujours l'activité principale. L'importance des activités de confort a décliné avec l'augmentation des niveaux d'eau et de la surface du bassin, qui a pu augmenter le risque de prédation potentielle. Cette étude permet de mieux comprendre les facteurs régissant l'utilisation de zones d'alimentation diurnes par les sarcelles d'hiver.

SUMMARY

In winter, dabbling ducks generally use a set of two distinct habitats over the 24-hour cycle, resting in large groups on a few large waterbodies during daylight hours, and dispersing at night into many smaller feeding habitats. In some circumstances, birds use the same site during both daylight hours and during the night. This study was conducted on a small (< 1 ha) pond used by Teal (*Anas crecca*) by day and by night in the early part of the winter. Duck numbers were not related either to the abundance of food resources, water levels or pond area. Teal had the same pattern of behaviour during daylight and at night, foraging being the main activity through the whole period of their presence on the site. Comfort activities decreased with increasing water levels and pond area, perhaps because the predation risk is greater in these conditions. This study contributes to understanding the factors affecting the use of diurnal feeding sites by Teal.

INTRODUCTION

Wintering dabbling ducks (Anatidae) generally have a complex pattern of behaviour over the 24 hours: resting and preening occur mainly during daylight

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hours, while feeding is primarily a nocturnal activity (Tamisier, 1976; 1978). The major requirements of these birds are an undisturbed habitat for comfort activities during the day and food-rich foraging habitats at night. Foraging habitats are generally small waterbodies used by a few birds at a time, while the resting place is often a large area which can host up to several thousand ducks (Tamisier, 1976; 1978; Pirot *et al.*, 1984). Previous work suggests that communal roosting during daylight hours is primarily an anti-predator strategy (Tamisier & Dehorter, 1999), and the low levels of foraging activity on the roosts could be due to a fast depletion of the food resources because of the large numbers of ducks present continuously (Tamisier, 1978).

In contrast, some birds use small waterbodies by day in some circumstances, as stopover or wintering sites. In particular, wintering Teal (*Anas crecca*) show a wide distribution over a variety of sites in North-West Europe: almost a quarter of Teal numbers are found by day in sites hosting less than 100 individuals (Rüger *et al.*, 1986). In the winter of 1996-97, 23 % of the dabbling ducks (26 % of Teal) wintering in the Marshes of Rochefort, Western France, used sites smaller than 10 hectares (Guillemain & Fritz, unpub. data). Such small waterbodies present the particularity of being day-roosts with the characteristics of nocturnal feeding habitats. They therefore offer the possibility to evaluate the importance of several factors on both comfort and feeding behaviours. The aim of this study was to monitor the 24-hour time-budgets of Teal and the evolution of Teal numbers on such a small pond, in relation to the food available, water levels and the area of the pond, i.e. food abundance, food accessibility and the availability of comfort areas.

High water levels are likely to reduce the accessibility of food for benthic-feeding birds. This is particularly true for dabbling ducks, which forage from the surface of the water and almost never dive. Teal are an extreme case: this granivorous species mostly forages by grubbing in shallow water, i.e. close to the shore (Tamisier, 1972a; Thomas, 1982; Pöysä, 1986), where most of preening and roosting activities also take place. If the edges of the pond are gently sloping, increased water levels lead to an increased area of shallow water, and thus to a larger area available to Teal. However, if the pond is bordered by a fringe of vegetation, increased water levels reduce the distance between shallow water areas and cover where a potential predator can hide (cf. Lazarus & Symonds, 1992; Pöysä, 1994). Even though high water levels increase the area available to Teal, the proximity to cover of feeding and comfort areas at high water levels may lead to the site becoming too risky for both these activities.

METHODS

During the winter, a thousand Teal are found on average in the Marshes of Rochefort, western France, concentrating on 4 major day roosts. Duck behaviour and abundance were monitored on a pond (approximately 1 ha) of the Réserve naturelle des marais d'Yves, close to Rochefort, which regularly serves, for a part of the winter, both as a feeding habitat and a resting place for about twenty Teal (A. Doumeret, pers. comm.). The Reserve as a whole is used during daylight hours by 150 Teal on average over the winter, most of them flocking on a roost (24 ha) less than one kilometre from our study pond.

Only data on Teal were analysed because other dabbling ducks (mainly Mallard *Anas platyrhynchos*) were present irregularly. Half of the pond is bordered

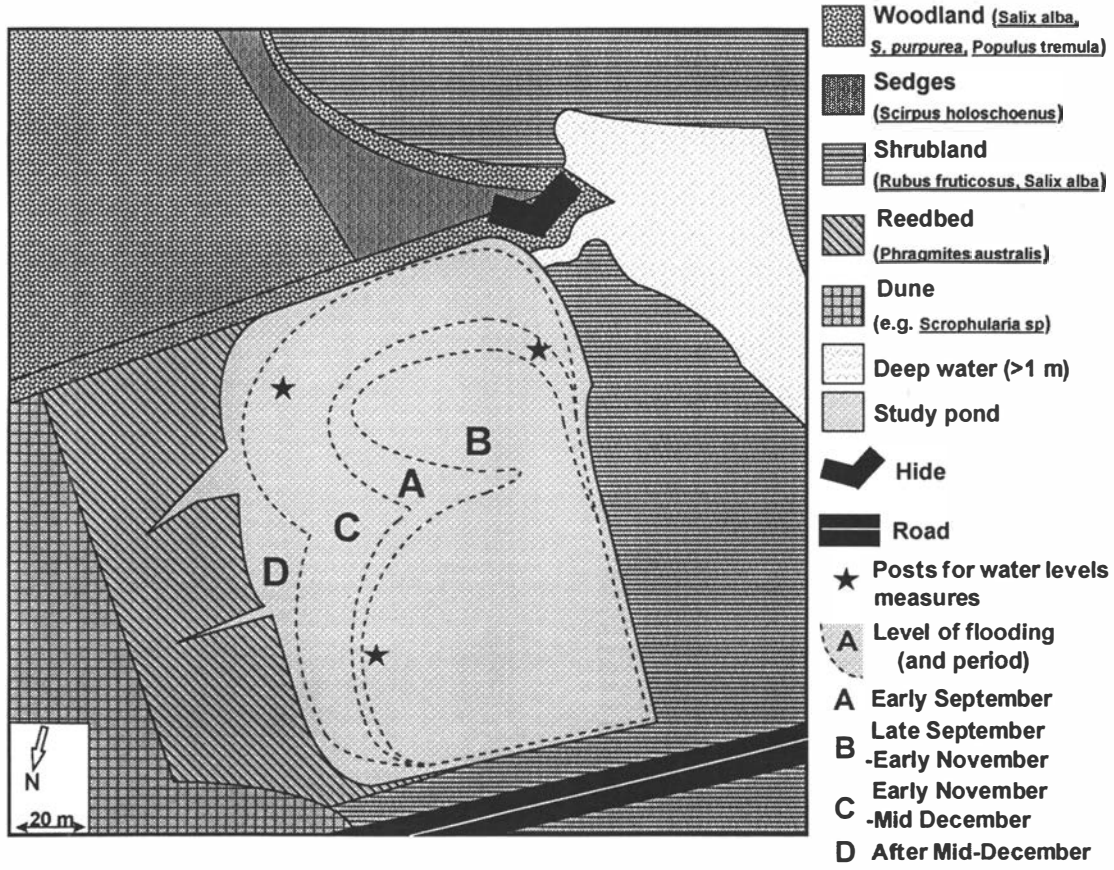

Figure 1. — The study pond and surrounding vegetation, in the Réserve naturelle des marais d'Yves, western France. Different levels of flooding over the winter, inferred from regular photographs taken from the hide, are presented.

by a reedbed (*Phragmites australis*) 2 metres high, the other half mainly by trees (*Salix alba, Salix purpurea* and *Populus tremula*) (Fig. 1). Duck numbers and activities were monitored each Friday from 06.IX.96 to 20.XII.96, when Teal no longer used the pond. Observations were performed in four periods: 2 hours before dawn, mid-morning, mid-afternoon and 2 hours after twilight. The maximum number of Teal counted during the two daylight observations was used to evaluate the weekly diurnal use of the area. The same procedure was followed for nocturnal numbers. Time spent in each behaviour was measured as the proportion of the individuals present showing each behaviour (scan sampling, Altman, 1974). Feeding, swimming, vigilance (i.e. either high vigilance or immobility with head raised) and comfort (i.e. preening or resting) were distinguished. Among foraging individuals, four feeding postures were distinguished: foraging with only the beak under the mud or water (hereafter Grubbing), foraging with head under water (Head), foraging with head and neck under water (Neck) and foraging with whole anterior part of the body submerged (Upending). Behaviours could not be distinguished during the nights of the first two weeks and the night of 27.IX.96 because of poor weather, so on these nights only the total number of individuals was noted.

Water levels were measured weekly at three posts (Fig. 1). Photographs of the pond were taken each Friday to estimate pond area on an arbitrary scale, i.e. proportion of open water relative to potential maximum pond area, which was limited by the surrounding vegetation. Figure 1 was also drawn from these photographs. Mud samples were taken with a core sampler at three points in the pond, chosen at chance each week. Samples represented approximately 5 cm of benthos, from an area of 540 cm^2. In the laboratory, these samples were filtered and mixed with sand and loam. The number of seeds was estimated after samples were allowed to germinate for 3 weeks, using the method of Ter Heerd *et al.* (1996).

RESULTS

TEAL ABUNDANCE IN RELATION TO BIOTIC AND ENVIRONMENTAL FACTORS

On average, 20.3 Teal (± 14.4 SD, n = 11) were present on the pond during daylight hours from 06.IX.96 to 22.XI.96; their numbers did not show any particular trend with time (Spearman rank correlation: $r = 0.46$, n = 11, $p > 0.05$), but suddenly fell to zero after 22.XI.96 (Fig. 2). During the night, the mean number of Teal was 14.00 (± 8.64 SD, n = 12) from 06.IX.96 to 22.XI.96: these numbers decreased with time ($r = -0.64$, n = 12, $p < 0.05$), and no ducks were found at night on the pond after 22.XI.96 (Fig. 2).

The number of seeds per sample decreased with time during the period when Teal were present on the site ($r = -0.84$, n = 11, $p < 0.002$) (Fig. 3). The number of Teal on the pond, either in daylight or at night, was not significantly related to the quantity of seeds in the sediment ($r = -0.33$, n = 11, $p > 0.05$ and $r = 0.57$, n = 11, $p > 0.05$, respectively).

Water levels and pond area were closely related ($r = 0.93$, n = 14, $p < 0.0001$, Fig. 4) and the relationship was linear (the banks were gently sloping). Water levels and pond area did not show any particular trend during the whole study

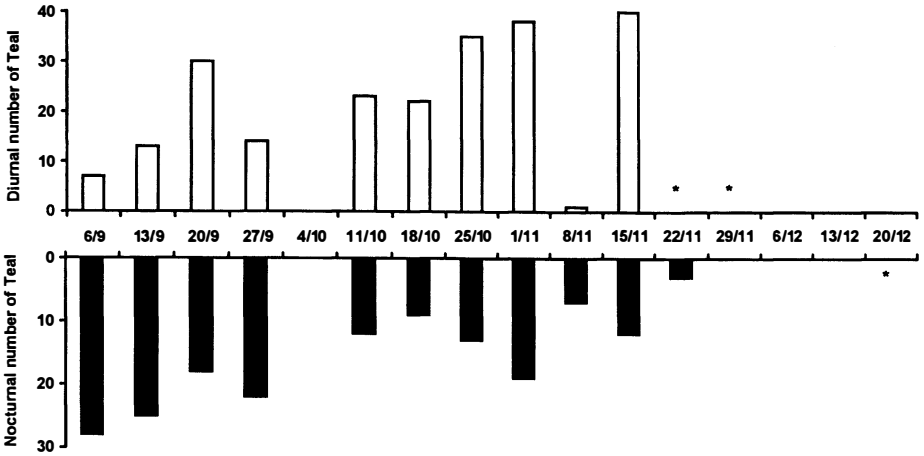

Figure 2. — Diurnal and nocturnal numbers of Teal on the study pond in the Réserve naturelle des marais d'Yves from September 6th to December 20th. Stars represent weeks with missing data.

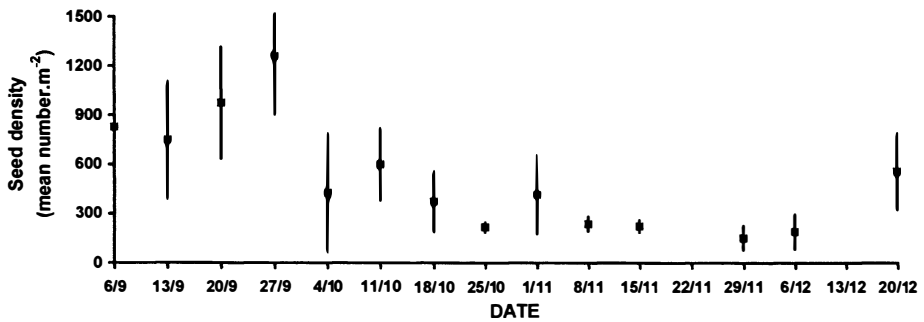

Figure 3. — Variations of the mean density of seeds. Vertical bars represent 95 % confidence intervals. The dashed arrow represents the period when Teal were present on the pond.

period ($r = 0.37$, n = 14, $p > 0.05$ and $r = 0.43$, n = 14, $p > 0.05$, respectively), but increased suddenly after 15.XI.96, reaching levels which were significantly higher than before this date ($Z_{12,2} = 2.11$, $p < 0.05$ and $Z_{12,2} = 2.10$, $p < 0.05$, respectively) (Fig. 5). The reedbed was flooded after 15.XI.96, and thus access to usable ground on the banks was reduced by half after this date.

When Teal were present on the pond, their abundance was not related either to water levels or pond area, both during daylight hours ($r = -0.14$, n = 11, $p > 0.05$ and $r = -0.45$, n = 11, $p > 0.05$, respectively) and at night ($r = -0.02$, n = 12, $p > 0.05$ and $r = -0.15$, n = 12, $p > 0.05$, respectively).

Diurnal and nocturnal behaviour of Teal

The time spent in foraging behaviours did not differ significantly between night and day, representing more than 60 % of the time-budget on average

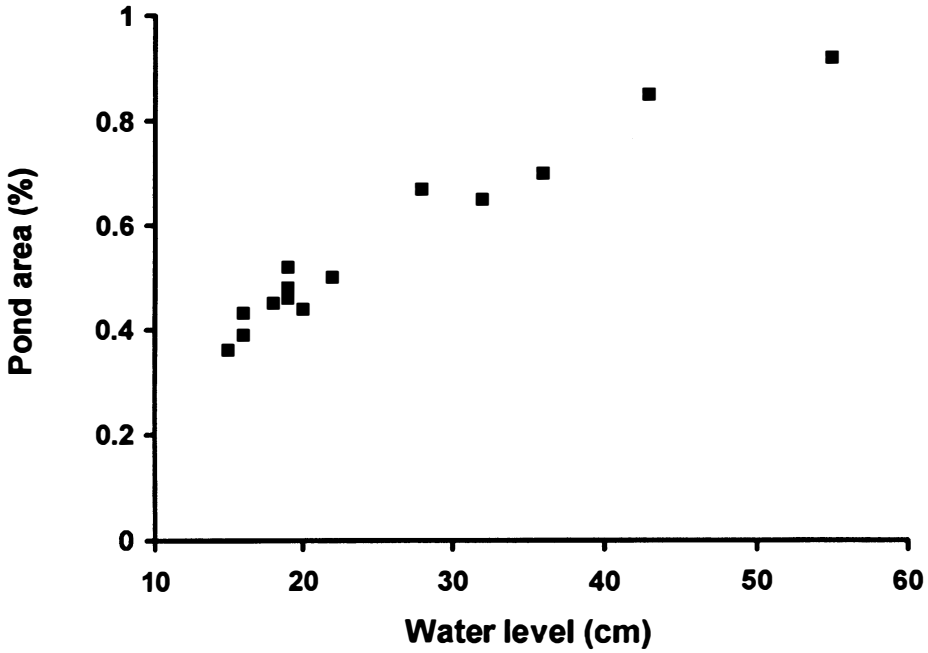

Figure 4. — Relationship between the pond area and the water level.

(Table I). The proportion of time spent foraging during daylight hours was not significantly related to the proportion of time spent foraging at night ($r = -0.11$, n = 7, $p > 0.05$). The proportion of diurnal and nocturnal foraging did not show any particular trend in the course of the winter ($r = -0.27$, n = 10, $p > 0.05$ and $r = -0.46$, n = 8, $p > 0.05$, respectively), and was not significantly related either to the quantity of seeds in the sediment ($r = 0.22$, n = 10, $p > 0.05$ and $r = 0.22$, n = 8,

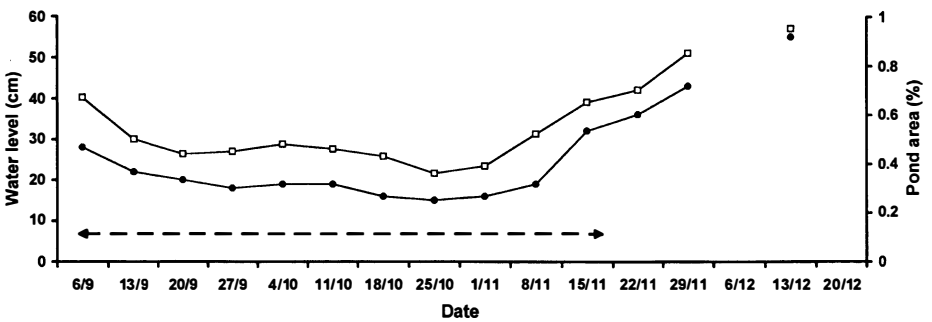

Figure 5. — Water level (black circles) and pond area (white squares) from September 6th to December 20th. The dashed arrow represents the period when Teal were present on the pond.

TABLE I

Mean proportion of time spent in the different activities on the study pond during daylight hours and during the night.

	Day (n = 10 scan samples)	Night (n = 8 scan samples)	Mann-Whitney Z	U-test p
Feeding	0.61 ± 0.30	0.70 ± 0.37	0.90	0.37
Comfort	0.19 ± 0.14	0.08 ± 0.22	– 1.85	0.06
Swimming	0.19 ± 0.31	0.18 ± 0.35	– 0.73	0.47
Vigilance	0.01 ± 0.01	0.04 ± 0.08	0.16	0.87

$p > 0.05$, respectively), to the pond area ($r = 0.10$, n = 10, $p > 0.05$ and $r = 0.12$, n = 8, $p > 0.05$, respectively) or to water levels ($r = 0.03$, n = 10, $p > 0.05$ and $r = 0.18$, n = 8, $p > 0.05$, respectively). Grubbing represented more than half of the foraging behaviours, both by day and at night.

Comfort activities did not represent more than 19 % of the diurnal time-budget, which was not significantly different from nocturnal comfort (Table I). No significant trend with time was found for this activity during daylight hours ($r = -0.04$, n = 10, $p > 0.05$), but the time spent in comfort behaviours decreased

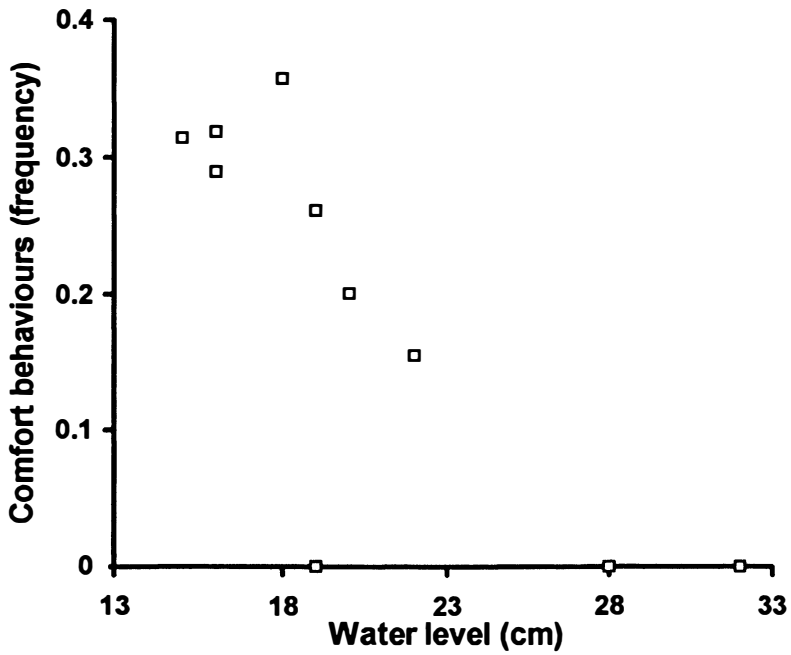

Figure 6. — Relationship between the frequency of comfort behaviours and water levels. $r = -0.81$, n = 10, $p < 0.01$. No comfort activity was observed on 18.X.96, 08.XI.96 and 15.XI.96 (left to right).

with increasing water levels (Fig. 6) and pond area ($r = -0.80$, n = 10, $p < 0.01$), the remaining time being occupied by other activities (e.g. swimming), whose frequency did not increase significantly.

DISCUSSION

Behaviour of Teal

The small impoundment of the nature reserve of Yves was used during 2.5 months after 06.IX.96, and for each of the 10 weeks where Teal were present during daylight, birds were also present at night. Teal had similar time-budgets during daylight and nocturnal hours. The behaviour of birds on this pond therefore differed from that so far described for wintering sites, where comfort was mainly diurnal while feeding occurred at night (Tamisier, 1976; 1978; Pirot *et al.*, 1984).

Teal fed intensively on our study pond, both during daylight and at night. There was no relationship between the proportion of time spent foraging during these two periods of the day, which suggests that diurnal feeding did not compensate for variations in feeding at night. Nocturnal feeding in Teal is usual, but daylight values in this study are higher than those in the Camargue (i.e. less than 10 % on average, Tamisier, 1972a, more than 60 % here) and similar to Thomas' (1982) observations in the Ouse Washes, England. Higher diurnal feeding times in north-west Europe and the Atlantic coast of France have already been noted by Tamisier (1972b) and attributed to higher energy needs during winter in sites further North. However, this large amount of time spent foraging in colder habitats cannot alone explain our high values of diurnal foraging.

Previous studies (Tamisier, 1972 a,b) suggested that diurnal flocking of Teal on large resting places was a response to predation by Marsh Harrier (*Circus aeruginosus*) and Yellow-legged Gull (*Larus cachinnans*) during daylight hours, associated with the absence of nocturnal predation. Predation attempts by Marsh Harrier on our study pond were very occasional, while no gull has ever been observed to attack ducks on the site. This low level of aerial predation may explain why Teal frequented the pond over the whole 24-hour cycle. The lack of a significant difference between diurnal and nocturnal time-budgets seems related both to the absence of aerial predation and to the good foraging opportunities of this site, which led to the spread of foraging activities over the 24-hour cycle.

Dry weather in early winter caused water levels and pond area (which were strongly correlated) to decrease from September to late October. This was followed by an increase in the water levels in November due to rainfall, when Teal deserted the pond.

Water levels affect the foraging behaviour of dabbling ducks, since these birds almost always feed from the surface of the water, and high floods can thus make food resources completely inaccessible (Thomas, 1982). On the other hand, higher water levels in ponds with gently sloping banks enlarge the area of shallow water, and can thus increase food accessibility for species like Teal that forage close to the edges of waterbodies (Tamisier, 1972a; Thomas, 1982; Pöysä, 1986; this study). In our study, the time allocated to foraging by Teal did not vary when water levels increased, and birds did not switch to foraging methods adapted to deeper water: grubbing remained the main foraging behaviour during the whole

period, suggesting that Teal followed the displacements of the water's edge rather than changing their behaviour in the deeper parts of the pond.

Increased water levels could have affected the pond's properties: since the area of open ground on the banks is limited by the fringe of tall vegetation, increasing water levels decrease the area available for preening and resting, behaviours which Teal perform mainly on the shore or in very shallow water (Tamisier, 1972a). Most of the Teal in comfort behaviours were located in the south eastern beach of the pond (pers. obs.), and the frequency of comfort behaviours decreased with increasing water levels. It is known that the distance to cover can affect the behaviour of animals because of the risk of predation (Lazarus & Symonds, 1992; Pöysä, 1994). In general, wintering dabbling ducks therefore perform their diurnal comfort activities on large waterbodies allowing an early detection of aerial predators (Tamisier, 1976; 1978; Pirot et *al.*, 1984). Figure 1 shows that the area of beaches was reduced considerably during high flooding after early November, which could have increased the predation risk during comfort activities. The reduction of the area accessible for comfort activities, because of flooding and because of proximity between comfort areas and the fringe of vegetation, could explain why Teal spent less time in comfort behaviour as water levels rose, and the sudden increase in flooding could thus be responsible for the departure of Teal through a deterioration of roosting conditions.

TEAL NUMBERS AND FOOD ABUNDANCE

We hypothesize that the presence of Teal feeding both by day and at night on the same pond has an important impact on the seed bank. Mud samples collected the year before this study showed that the seed bank in this pond was mainly composed of *Potamogeton pectinatus, Suaeda fruticosa* and *Ruppia maritima.* Mean weights of these seeds (data from Campredon *et al.* 1982) suggest that seed biomass decreased from approximately 17 kg/ha at the beginning of the season to 4.5 at the departure of the birds, 70 days later, and subsequently stayed at the same level. Even at the beginning of the season, the seed density was half that of the poorest habitat in the Camargue, France (Tamisier, 1971), and showed a 73 % decrease during the study period. This is far higher than the trophic impact of Teal in the Camargue (i.e. 5.54 % on average, ratio of food consumed to food available, Tamisier & Dehorter, 1999). The rate of decrease is however in the range of what Teal can consume, since it represents 20 grams per Teal per day. The daily food ingestion by this species is around 35 grams of seeds per day (Tamisier & Dehorter, 1999). Other duck species such as Mallard also feed on this type of seeds (mainly *Potamogeton* sp., Tamisier pers. comm.), but the low numbers and the irregular presence of these ducks on the pond suggest that their impact on food resources was low compared to the effect of Teal.

Food depletion due to consumption by Teal is thus likely to have occurred during the period when they were present on the pond. Teal numbers did not decrease gradually with decreasing food abundance, rather, the site was abandoned at the same time by all birds, which suggests that if food depletion was responsible for the departure of ducks, this phenomenon occurred suddenly, and affected the whole group.

This study shows that the same site, which resembles the usual nocturnal feeding habitat of dabbling ducks (small area and shallow water), can be used by

Teal both at night and during daylight hours. Tamisier (1976) suggested that small areas surrounding huge Pintail and Green-winged Teal roosts in Louisiana hosted principally migratory birds in transit, while large roosts were frequented by wintering individuals. Higher feeding activity was observed on the smaller areas, which was related to the higher energy needs of the migratory birds. Our study pond was also used temporarily but, at present, it is not possible to assess if birds using the pond at the beginning of the winter subsequently joined the larger roost of the reserve, or migrated elsewhere. This, and the possible fidelity of the birds to the pond over the 24-hour cycle, could be tested by a program of ringing or radio-telemetry. Almost a quarter of Teal wintering in North-West Europe use sites hosting less than 100 individuals (Rüger *et al.*, 1986). Our study contributes to understand the factors affecting the use of such wetlands by Teal over the 24-hour cycle.

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