Studies of the behaviour of the White-winged Wood Duck *Cairina scutulata* in captivity

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The White-winged Wood Duck *Cairina scutulata* is an endangered species of wildfowl from Southeast Asia that has undergone a drastic decline this century due primarily to the ongoing destruction of its lowland tropical forest habitat (Green 1992, and this volume). It is a non-typical wildfowl found in small wetlands amidst moist tropical forest, and is relatively difficult to survey and study owing to its closed forest habitat, retiring habits and absence of flock formation with the great majority of sightings being of single birds and pairs, and no confirmed records of groups of more than 11 birds.

There are many questions about the biology of the species in the wild that remain unanswered (Green 1992 and in press). In order to increase our understanding of its biology, and to assist in the development of survey and research techniques that can be applied in the field, studies in captivity at Slimbridge were initiated in 1989. These have included studies of the nature and function of vocalizations (Etheridge, Fullager & Green in prep.) and of how variation in the extent of white plumage in the captive stock is related to ageing, inbreeding and sexual differences (Pickering, Webber, Green & Gummer in prep.). Here, we present the results of investigations into the response of captive White-winged Wood Duck to playback of conspecific vocalizations, into the diel rhythms and time budgets of the birds and into methods and effects of attaching radio-transmitters.

General methods

Observations were made of four pairs of birds each housed in a separate pen at Slimbridge that held no other captive birds but suffered regular intrusions from wild birds such as moorhens, sparrow and chaffinches. Each duck was marked with a metal ring and a Darvic ring to make individual recognition easy. The four pairs of birds observed were as follows:
Pair 1: Male 1, Darvic AC, Metal S2038; Female 1, Darvic AX, Metal S1889
Pair 2: Male 2, Darvic AD, Metal S1302; Female 2, Darvic AA, Metal S2036
Pair 3: Male 3, Darvic BN, Metal S1478; Female 3, Darvic BY, Metal S1471
Pair 4: Male 4, Darvic CU, Metal M1292; Female 4, Darvic AB, Metal S2037.

Playback

Playback of conspecific vocalizations has been shown to aid location of some woodland and forest species by inducing a vocal response (e.g. Mosher *et al.* 1990), and may be a valuable technique for use in field surveys of *C. scutulata*, a species that is very difficult to locate in the wild (Green 1992). One similar study of the effect of playback of an Anatidae species in the wild is that of Whitten (1973) who played a tape of conspecific calls to a pair of Blue Duck *Hymenolaimus malacorhynchos*. The male of this pair called in response and made repeated approaches to the tape recorder, and on one occasion the pair copulated immediately after playback. The technique was considered to be of potential use in surveys by inducing Blue Duck to show themselves.

Intensive observations were made of *C. scutulata* Pairs 1 and 2 between 15 April and 19 May 1991. These birds were held within the public grounds, so observations were made before or after the public were admitted from 0615 h to 0800 h or from 1745 h to 1845 h. The birds' behaviour was recorded simultaneously with a Sony Walkman Professional tape-recorder and a JVC 59 video-recorder. In each observation session, the birds were recorded for 9 minutes with 3 min before, 3 min during and 3 min after playback of a stimulus tape through a

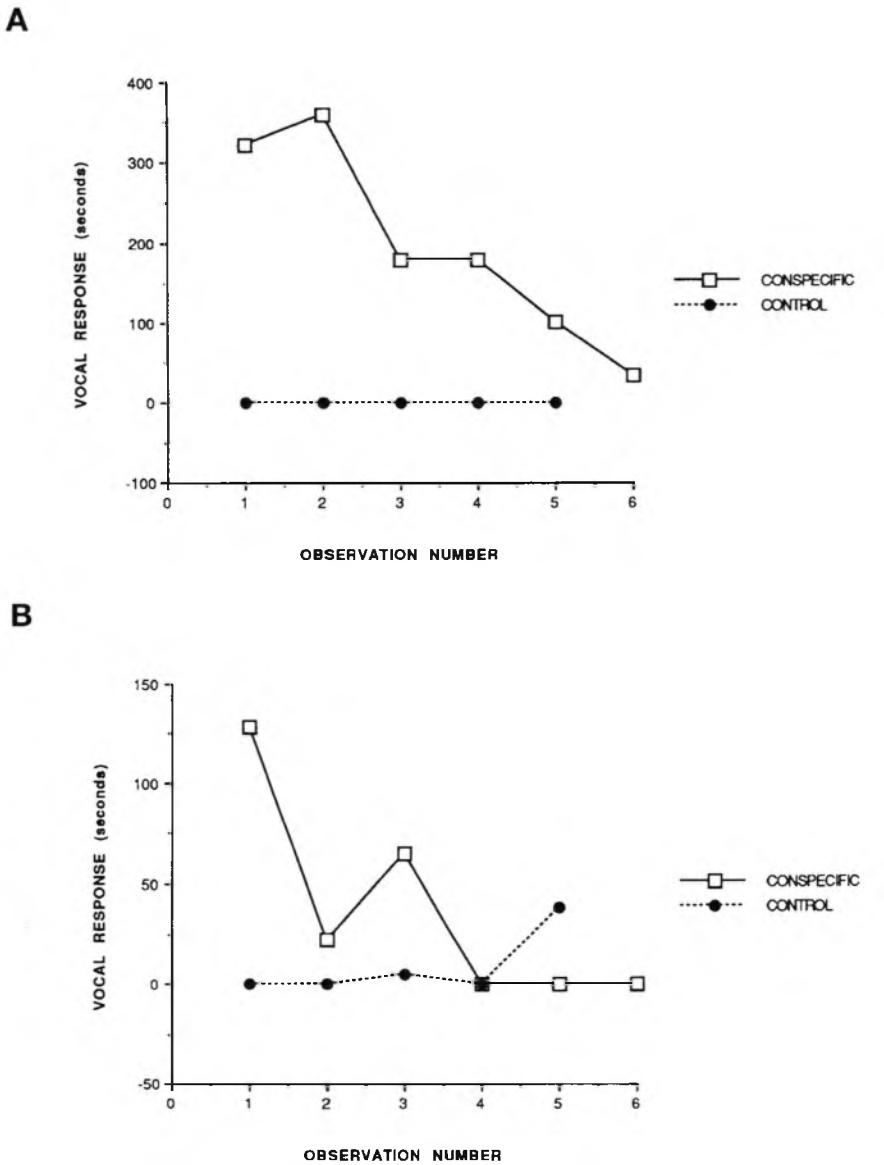

Figure 1. Vocal response by *C. scutulata* to conspecific and control playback in A) Pair 2 and B) Pair 1. Vocal response = total time spent calling during 3 min of playback - total time spent calling during 3 min before playback. A tape of Barnacle Geese *Branta leucopsis* was used for the controls.

stereo cassette player with twin speakers. Two tapes were used: a *C. scutulata* tape made with alternating male and female calls from unfamiliar birds kept 675 m away from the study birds, and a control tape of recordings of Barnacle Geese *Branta leucopsis*. Eleven observations were made of each pair, six with the conspecific tape and five with the control tape. Use of conspecific or control tape was decided on a random basis on each occasion.

Due to problems in observing the birds in dense vegetation in the pens and poor quality of the video tapes, it was not possible to quantify the time spent by birds in behavioural categories such as comfort behaviour, sleeping etc. Thus activity was quantified simply as calling or not, and on

land or on water, behaviours considered most relevant to how conspicuous the birds were to an observer. These experiments were conducted during the breeding season, and females in both pairs spent most of the observation periods in nest boxes. Female 1 began to lay between the fourth and fifth of the 11 sessions, whilst Female 2 began to lay between the third and fourth of the 11 sessions. Consequently, behavioural response to playback was largely confined to the males in each pair and the behaviours were summed for each pair to simplify analysis.

Vocal response to playback

Females only called during two of the 22 sessions, both during conspecific playback. Males called during 11 sessions. Pair 2 never called during control sessions. In conspecific sessions they never called in the 3 min before playback and called significantly more during the 3 min of playback (one-tailed Wilcoxon test, T = 0, $P = 0.018$, Fig. 1A). The increase in calling during playback was significantly greater during conspecific sessions than during controls (one-tailed Mann Whitney U test, $n = 11$, U = 0, $P = 0.002$). During both conspecific and control treatments, Pair 1 called more during playback than before but not significantly so (one-tailed Wilcoxon tests: conspecific T = 6, $P = 0.09$; control T = 3, $P = 0.19$, Fig. 1B). Although the increase in calling was more marked during conspecific playback than during control playback, there was no significant difference between treatments (one-tailed Mann Whitney U test, $n = 11$, U = 11.5, $P = 0.292$).

Both pairs showed evidence of habituation during the experiment, with a reduced vocal response in later trials (Fig. 1). There is no evidence of a delayed response to playback, as neither pair did significantly more calling in the 3 min after playback than in the 3 min before (one-tailed Wilcoxon tests $P>0.05$ NS). Using Fisher's method of combining probabilities (Sokal & Rohlf 1981) for both pairs, there was significantly more calling during conspecific playback than before ($X^2 = 12.85$, 4 df, $P<0.05$), and conspecific playback increases calling significantly more than control playback ($X^2 = 14.89$, 4 df, $P<0.01$).

Non-vocal response to playback

Calling during playback always occurred while adopting an alert posture, and was often accompanied by head-bobbing and by approaching the tape recorder. There was no evidence of a difference in the time spent on water in the 3 min periods before, during or after playback for conspecific or control treatments (two-tailed matched paired t-tests, $P>0.05$ NS, Fig. 2). Likewise there is no difference in the effect of playback on time spent on the water between conspecific and control treatments (two-tailed two sample t-tests, $P>0.05$ NS, Fig. 2). On the first occasion that Pair 2 were subjected to conspecific playback, they attempted a copulation during playback.

Other observations

Additional observations were made of the response of approximately 20 *C. scutulata* to playback of conspecific calls between December 1990 and October 1991. While Females 1 and 2 were relatively inactive during these experiments, during earlier trials they gave strong vocal responses to conspecific playback. Separate observations of these and other birds found that both sexes in paired adult birds give vocal response before, during and after the breeding season in December, January, March, April and October. On at least four occasions in at least two pairs, playback initiated a particularly strong response in which inactive birds appeared from undergrowth as soon as playback began and commenced a loud vocal response accompanied by head-bobbing display that continued for some minutes after the playback tape was switched off. Pair 2 responded on three occasions by commencing mutual calling and head-bobbing display on the water together. All birds subjected repeatedly to playback reduced their response over time, suggesting habituation. Two groups of immature birds (with five and 11 individuals), and two adult birds kept alone did not give a vocal response to playback.

Discussion

C. scutulata in captivity respond to playback of unfamiliar conspecific vocalizations by calling, and so playback may be a useful technique for locating the species in

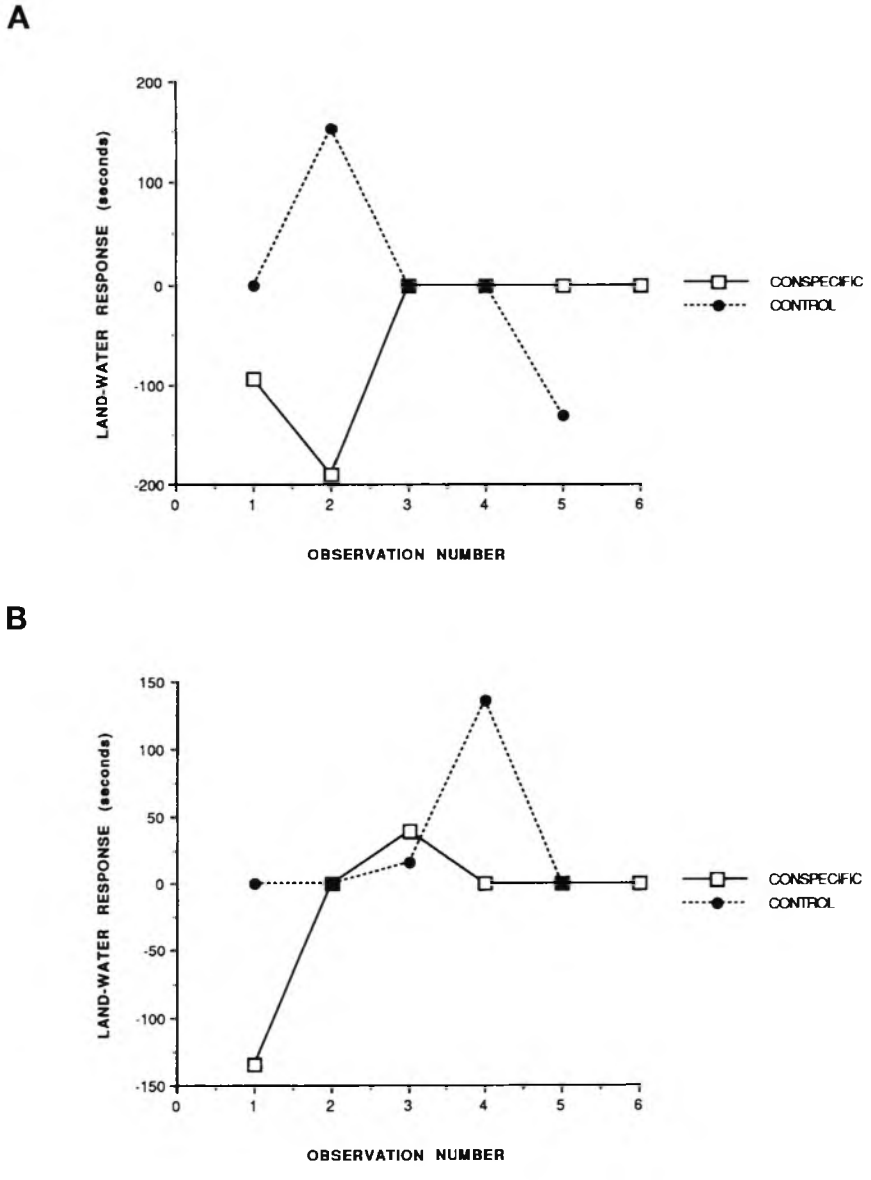

Figure 2. Land-water response by *C. scutulata* to conspecific and control playback in A) Pair 2 and B) Pair 1. Land-water response = total time spent on the water during 3 min of playback - total time spent on the water during 3 min before playback. A tape of Barnacle Geese *Branta leucopsis* was used for the controls.

the field. While the birds make themselves more conspicuous by calling, there is no evidence that they show themselves by coming out of the vegetation onto the water. The observed copulation attempt may have been a direct response to playback, and is similar to the observation of Whitten (1973) of a pair of Blue Duck copulating during conspecific playback.

The playback technique may play a valuable role in surveying *C. scutulata* and hence in planning the conservation of this endangered bird. *C. scutulata* spends much of the day roosting in forest trees, where it is extremely hard to observe unless flushed by accident. Most records are of birds seen in flight around dawn and dusk when they move between feeding and

roosting sites. *C. scutulata* often call in flight, and are often heard in flight without being seen (Green 1992). Efforts to locate and census *C. scutulata* in the field seem likely to be more successful if birds can be stimulated to call in response to conspecific playback. This method may also allow the location of breeding pairs at the nest, since males in captivity continued to respond after the females began to sit on their eggs. Breeding pairs of *C. scutulata* at the nest are difficult to locate and only three have ever been described (Husain & Haque 1982).

C. scutulata playback was recently attempted for the first time in the field without success (Eames & Robson 1991). However, this was in an area of Vietnam with only one confirmed record in the past 50 years. The playback technique should be tested in other sites known to hold a substantial population, such as Way Kambas National Park, Sumatra, which holds a population of some 30 birds. The observations in captivity suggest playback is likely to be most effective at locating mature adult birds in breeding condition, and to be least effective at locating juveniles. However, firm conclusions cannot be made from these limited observations of captive, pinioned birds.

Behavioural time budgets and rhythms

Little is known of the time budgets and diel rhythms of *C. scutulata* in the wild, except that they show peaks of feeding and flying activity around dawn and dusk periods (Green 1992 and in press). To study time budgets and diel rhythms in captivity, the behaviours of Pairs 1, 2 and 3 were observed for a total of 78 hours outside the breeding season between 4 September 1991 and 19 November 1991. The behaviours of the birds were sampled at 30 second intervals in observation periods of 60 minutes that were spread evenly through daylight hours. No observations were made at night. Pair 3 was observed from a hide alongside the pen. Pairs 1 and 2 were observed from a position in view to the birds, but their behaviour did not seem to be affected by the presence of the observer. Pairs 1 and 2 were likely to have been habituated to the presence of people through being exhibited for most of their lives in the public grounds. Five minutes were allowed to elapse between the observer arriving at the pen and starting to record behaviour, to give the birds time to get used to the presence of the observer. Behaviour was divided into the following categories:

Resting - sleeping, standing or sitting.
Moving - walking, running or swimming.
Comfort - preening or bathing.
Feeding - feeding or drinking, whether moving or stationary.
Social - calling or head-bobbing, whether moving or stationary.

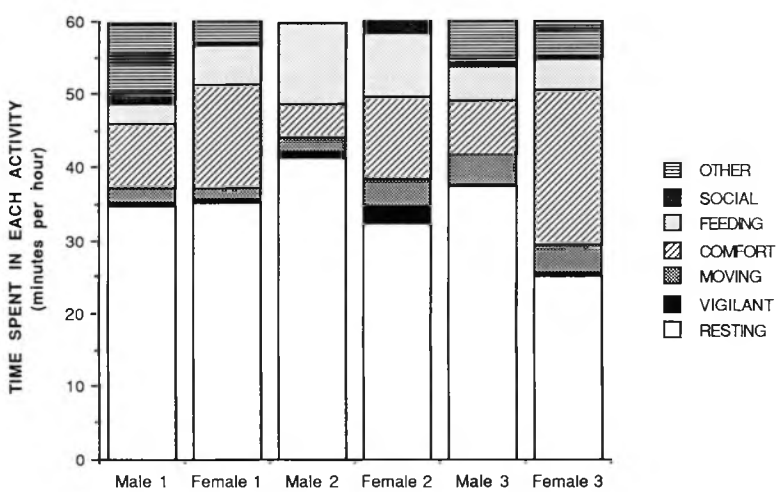

Figure 3. Time budgets of three pairs of *C. scutulata*.

Vigilant - raised head, alert behaviour, standing still.
Other - birds out of view to observer, and various minor categories.

Activity was recorded as the behaviour a bird was performing at the time of sampling. If a bird's behaviour was changing from one category to another, it was recorded as the category it was beginning to perform.

Time budgets

As can be expected, there are variations in the time budgets of individual birds, both within and between pairs (Fig. 3). However, Resting is consistently the dominant activity, with Comfort and Feeding the second and third most frequent. The category Other is comprised largely of time birds spent out of view, and birds generally moved out of view when they were being most active, Feeding and Moving. These behaviours may therefore be under represented in the data. Pair 2 spent a greater proportion of time Feeding than the other pairs. These birds spent a large amount of time grazing and dabbling, while the other pairs fed mainly on the grain provided in food trays. To derive similar energetic benefit through grazing and dabbling is more time consuming than feeding from a concentrated source of grain. Pair 2 were held in a pen that offered better conditions for grazing and dabbling than either of the other pens, having plenty of grass and a stream-fed pond that probably held more food.

Figure 4 summarises the data in an overall time budget, and shows that very little time was spent in Social or Vigilant behaviour. A further 15 hours of observations of *C. scutulata* Pair 4 were made during the breeding season from 10 April 1991 to 3 May 1991. These observations were concentrated in the early morning and evening, and so cannot be used to produce a balanced time budget directly comparable to those of Figure 3. The female spent over 90% of the observation time incubating a clutch, while the male had a very similar time budget to the birds in Figure 3.

Diel rhythms

In captivity as in the wild, the birds show evidence of a crepuscular rhythm, with Feeding peaking in the early morning and evening and Resting peaking in the middle of the day (Fig. 5). Other behavioural categories do not show such a clear rhythm. It is not certain whether this represents in any sense a "natural" rhythm as the birds were routinely fed by ground staff between 0900 and 1000 h and again between 1600 and 1700 h and may simply be adapting to this routine. In addition, these observations were made during the autumn and winter months when dawn and dusk were nearer to feeding time. All the birds were observed to feed intensely on grain immediately after it was provided and then

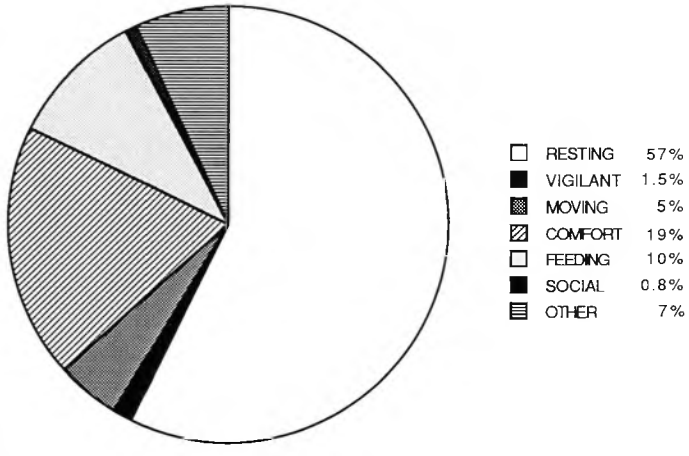

Figure 4. Overall time budget for White-winged Wood Duck pairs 1, 2 and 3.

more leisurely on naturally occurring foods. In all three pens, visiting wild birds such as sparrows and chaffinches took a large proportion of the grain provided, and the food trays were usually empty by feeding times. The Wood Duck may therefore have fed on the grain as soon as it was provided to ensure that they obtained enough. However, the rhythms suggest peaks in activity some time before and some time after food was provided (Fig. 5) which is consistent with the view that their crepuscular rhythm is at least partly a "natural" phenomenon. The rhythm of Pair 1 may also result partly from being held in the public grounds, with the birds being inactive during the middle of the day because disturbance from visitors is then at its highest. Pair 2 were moved into a secluded pen out of the public grounds a week before observations began.

Discussion

On average, the Wood Duck spent 57% of the observation time Resting, 19% in Comfort, and 10% Feeding. In contrast, captive Nene *Branta sandvicensis* at Slimbridge

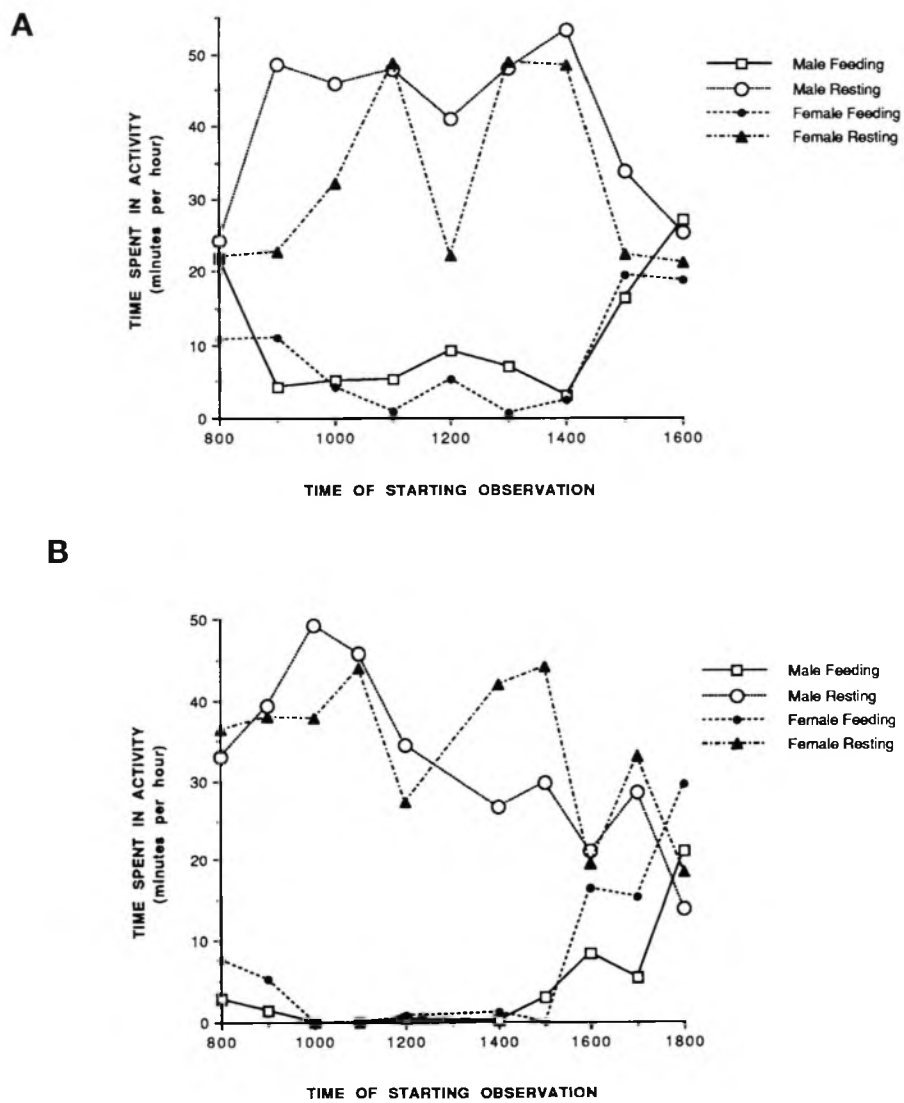

Figure 5. Diurnal rhythms of Feeding and Resting for White-winged Wood Duck A) Pair 2 B) Pair 1.

spend 19% of daylight hours Resting during the non-breeding season, 24% Feeding and 12% in Comfort (Black *et al.* 1991). The behaviour of *C. scutulata* is more similar to the behaviour of three diving ducks recorded in the wild in Spain. Amat (1984), found Pochard *Aythya ferina*, Tufted Duck *A. fuligula*, and White-headed Duck *Oxyura leucocephala* spent more than 50% of daylight hours during the non-breeding season Resting, 5% Feeding and 5% in Comfort.

On the basis of these limited observations *C. scutulata* in captivity appear to be relatively inactive during daylight hours, spending most of their time resting or in comfort behaviours and very little time in social behaviour. This is consistent with the birds' inconspicuousness in the wild, and supports the view that playback may be a valuable survey technique. However, these data may prove to be unrepresentative of the behaviour of the species in the wild, for a number of reasons. The captive birds at Slimbridge are pinioned, kept in a climate much colder than they would ever encounter in the wild, fed in an artificial way and are highly susceptible to infection with Avian Tuberculosis (Cromie *et al.* 1991 and in prep.).

Observations of captive birds showing a crepuscular rhythm in feeding activity agree with those in the wild, but remain inconclusive until studies involving the manipulation of feeding times are carried out, with levels of disturbance constant throughout the day. Regular observations of Pair 3 feeding by grazing on land are intriguing, as wild birds have so far only been recorded feeding on the water on plant and animal matter, by dabbling, upending and occasionally taking short dives for small fish, etc. (Green 1992). It remains possible that wild birds feed on land at times.

These observations have only recorded activity during daylight hours, and it remains very possible that feeding and social behaviour occur during the night. Wood Duck at Slimbridge have often been heard calling at night, although no systematic observations have been made. In the wild there are observations of flying and feeding at night, especially in disturbed areas such as rice fields, and there is some suggestion that birds are particularly active on moonlit nights when there is sufficient light to feed by (Green 1992). Further observations in captivity of behaviour at night in relation to the availability of light would be worthwhile to obtain a clearer overall picture of rhythms and time budgets.

Radio-transmitter studies

A dummy radio-transmitter was attached to Male 2 with a back-mounted harness (see Van Vessem & Draulans 1987) on 19 November 1991, and continued observations of the pair were made as described above. The birds were observed for a total of 20 hours until the transmitter fell off on 4 December 1991, owing to wearing of the harness fabric. The pair were then observed for a further four hours over the next two days.

Following attachment of the transmitter, Male 2 showed a marked increase in the amount of time spent in Comfort from 7.5% before attachment to 35% during attachment, and showing an immediate decline to 24% after the transmitter fell off. Conversely, he showed a marked decrease in the amount of time spent Feeding from 18% before attachment to 5.4% during attachment, and showing an immediate increase to 12% after the transmitter fell off (Fig. 6A). The male was seen to spend long periods of time trying to remove the transmitter. In contrast, there was little change in the behaviour of Female 2 when the radio-transmitter was attached to the male (Fig. 6B). The daily means of the time Male 2 and Female 2 spent Feeding and in Comfort during the study period are shown in Figure 7. Although there is much variation between days, Male 2 shows a clear pattern of increased Comfort and decreased Feeding while the transmitter is attached. This is reflected in the comparison of the male's and female's behaviour, which shows synchronised variation suggesting that both birds tend to perform the same behaviours simultaneously. Before attachment, Male 2 generally fed more and preened less than Female 2. After attachment this situation was reversed. Male 2 was weighed prior to attachment of the transmitter and after it became detached. He showed a slight weight gain of 20 g over this period, 0.9% of his body weight.

Discussion

Male 2 showed a clear decline in time

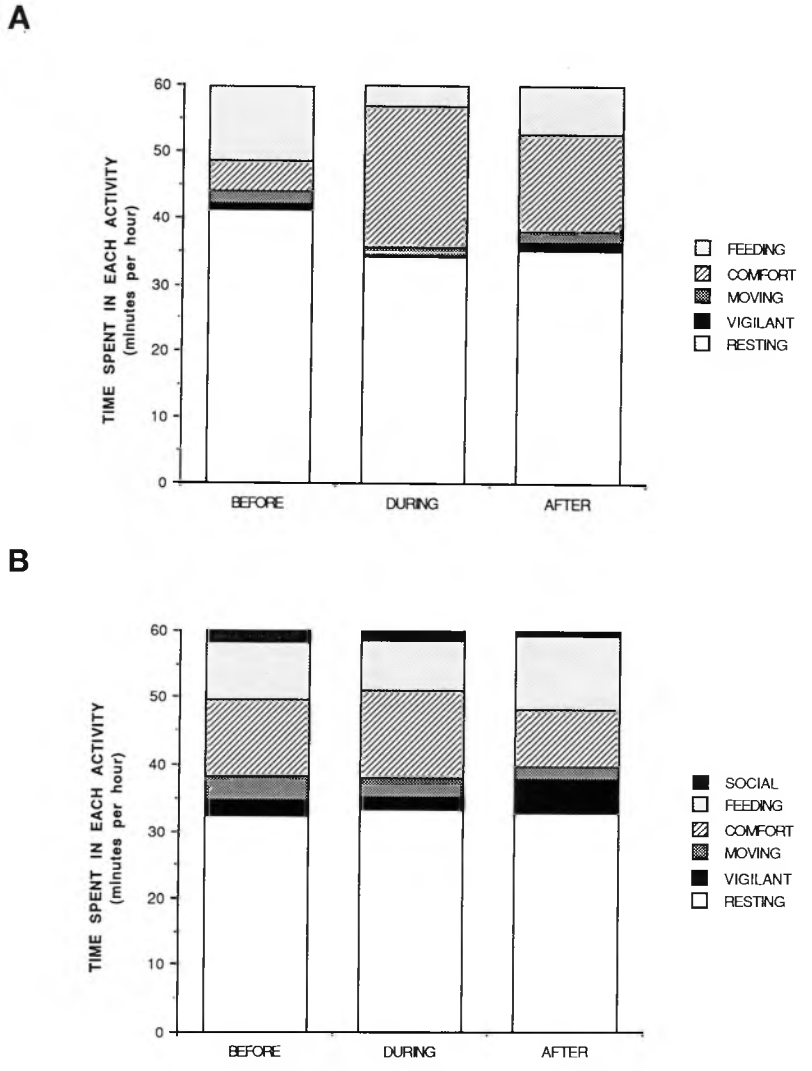

Figure 6. Time budgets of White-winged Wood Duck Pair 2 before, during and after attachment of a dummy radio-transmitter on Male 2. A) time budget of Male 2. B) time budget of Female 2.

spent Feeding and increase in time spent Resting during transmitter attachment. This is no doubt in response to the discomfort caused by the harness and transmitter. There is no clear evidence of a return to earlier levels of feeding and preening activity towards the end of the attachment period that would indicate some adjustment to carrying the transmitter (Fig. 7). This may simply have been because the transmitter did not remain attached for long enough. Immediately after the transmitter became detached, Feeding remained at a lower level and Comfort behaviour at a higher level than before attachment, suggesting a residual effect of attachment. Had observations continued for longer after the transmitter fell off, there would probably have been a more complete return to the earlier behaviour pattern.

The reduced time spent Feeding by Male 2 while the transmitter was attached results from the increase in Comfort behaviour, which was increased more at the expense of Feeding than of Resting and other activities (Fig. 6). This is cause for concern as it suggests attaching transmitters to wild birds could have a detrimental effect on their health and indicates the

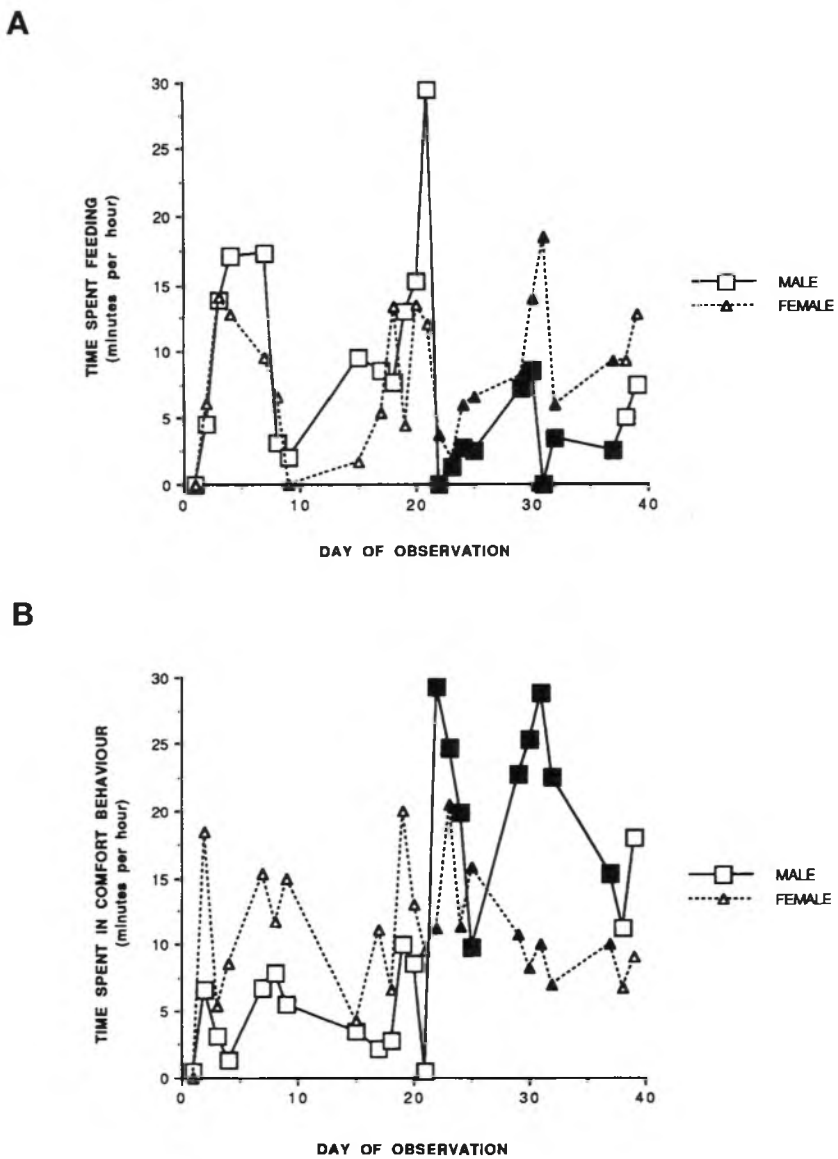

Figure 7. Time spent A) Feeding and B) in Comfort for White-winged Wood Duck Pair 2 during the transmitter study. Plotted as daily means with solid triangles and squares indicating the period when Male 2 was wearing a transmitter. Day 1 is 19 November 1991.

need for further research (preferably on fully-winged birds) into methods and effects of transmitter attachment before transmitters are used in the field. In future it will be necessary to find a stronger fabric than that used to attach the transmitter in the current study. However, the birds were only observed during daylight hours and the male may have avoided a reduction in food intake by increasing his feeding at night (see above). The fact that his weight remained stable over the study period supports this possibility. Alternatively, the weight stability could be explained if the male fed more efficiently while carrying the transmitter, by increasing feeding on grain and reducing grazing and dabbling.

Trials using dummy tail-mounted radio transmitters (see Giroux *et al.* 1988) on

Whitė-winged Wood Duck have also been carried out at Slimbridge (Linton 1991). Most of these were detached by the birds shortly after attachment. Six of seven transmitters were detached within three months, two of them within eight days. Furthermore, the transmitters were badly damaged with antennae well chewed or removed. Coupled with a short lifetime resulting from loss during moulting, tail-mounting was concluded to be an unsuitable mode of transmitter attachment for *C. scutulata*. Feeding was found to decrease and comfort behaviour increase after transmitter attachment, as in the current study. The birds with transmitters attached also gained weight by a mean of 17 g while control birds without transmitters lost a mean of 51 g, although this difference was not statistically significant. The weight loss in control birds may have been due to performance of aggressive and display behaviour at the beginning of the breeding season. These behaviours were shown less frequently by birds with transmitters attached, although there is no evidence of a causal link.

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