

common in Tunisia in spring (Morgan, 1982). Similar patterns have recently been confirmed by Beintema *et al.* (1985) for Black-tailed Godwits *Limosa limosa* and Ruffs *Philomachus pugnax*, which are numerous in Italy, especially in spring. It is likely that these birds come not only from the inner delta of the Niger (Mali) and the area around Lake Chad, but also from West African wetlands. Counts and ringing studies in the Mediterranean wetlands, especially in spring, are needed to update information on numbers, origin and migration routes of the birds involved. Mediterranean wetlands appear to be of much greater importance to waders than previously thought, both in winter and during migration. Italian ringers have recently initiated studies to fill this gap in our knowledge; ringing activities in Rades, Tunisia, are also being revitalized.

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- Cor J. Smit, IWRB Wader Research Group, c/o Research Institute for Nature Management, P.O. Box 59, 1790 AB Den Burg, The Netherlands.

## DIURNAL AND SEASONAL VARIABILITY IN THE BREEDING BEHAVIOUR AND DETECTABILITY OF SNIPE

by T.M. Reed

For almost all bird species there is, in the breeding season, a bimodal peak in vocal activity during the day, with most activity in the hour or so around dawn, a lesser peak near dusk (Emlen 1971; Reddig 1978; Skirvin 1980; Reed *et al.* 1983, 1985). The existence of such strong variability in bird behaviour might be expected to affect the results of censuses of Snipe carried out at different times of day. Reed *et al.* (1983, 1985) have shown diurnal variability in detectability for several species of wader. Here I compare the results of Snipe *Gallinago gallinago* censuses carried out on an area of damp pasture in Cambridgeshire in the first few hours after dawn, and then on the same area later in the day.

#### STUDY AREA AND METHODS

A 94 ha. tract of washland (winter flooded meadows) on the Ouse washes, Cambridgeshire was censused on five days between the start of May and the end of June 1984. The area surveyed was divided into individual washes, each approximately 100 m wide, bounded laterally by straight drainage channels and at the ends by canalised rivers 800 m apart. The washes were used for periodic grazing or cut for hay after the completion of the study. The particular block chosen was known to hold high populations

of Snipe (Green pers. comm.), and was nest-searched independently of the current survey (Green 1985), allowing comparisons of behavioural changes against the stage of the breeding cycle.

The study area was visited twice a day every 14 days from 1 May until 25 June by two observers. Between 05.00 and 08.30 on each day, just after dawn, observers walked approximately 100 m apart, following the straight drainage channels, recording all Snipe seen or heard on 1:5 000 scale maps. Observers met at the head of each wash and compared records to reduce double recording. After completing the survey, observers left the washland for 3-4 hours before resurveying the area between 11.15 and 14.10, starting at the opposite end, and walking in the opposite direction, to the previous visit.

At the end of each day, observations were transferred onto summary maps. For each visit observations were subdivided into 5 types:

1. Non-sound observations: observations where birds did not make a sound.
2. Alarm calls: the single note alarm call given when flushed, usually whilst feeding on a channel edge.

For each day the numbers of sound and non-sound observations were compared between early-morning and late-morning visits. Drumming is included in sound displays.

## RESULTS AND DISCUSSION

Initially it had been hoped to survey the whole washland tract twice on each survey day. However, rising floodwater in late May meant that a reduced area was surveyed on the second visit of the third day's censusing.

### Early and late visits

On every occasion (Table 1), early-morning visits produced more records than visits to the same area later in the day.

With the exception of the census visits on 14 May, the percentage of vocal and non-vocal observations were very similar. The activity patterns were consistent, with only their magnitude differing.

On both early-morning and late-morning visits the absolute and relative frequencies of alarm calls fell to a minimum on the third census day (late May), before rising on subsequent censuses. Other calls were a minor component of observations in any visit (except the first), differing little diurnally or seasonally.

The consistently most important record types, at either time of day, were drumming and chipping. Although an important proportion of all records, the functional significance of chipping is not clear. In a study of colour-marked male birds on part of the survey area, R.E. Green (in prep.) found that frequency and duration of chipping differed significantly between individuals, and had no obvious relationship with the stage of egg-laying, incubation or hatching. Both early in the morning and later in the day, chipping increased from mid May to a peak in mid June, when it accounted for over 50% of observations, dropping sharply on the final census day in late June.

The frequency of drumming displays differed markedly according to the time of day. On the first two early-morning visits (in the first half of May) 16-19 drumming birds were recorded, yet only 1-2 were recorded later on the same days. Numbers recorded declined to

stay between 5 and 7 birds on subsequent early-morning visits, with numbers remaining at 1-2 on subsequent late-morning visits. Such strong disparity within a space of several hours or over the course of the season cannot be readily explained by variations in the weather. On all census days the weather was similar: relatively light winds on the initial visit, with a slight increase in wind speed and break in cloud cover before the second visit of the day.

Tuck (1972) and Green (1985) have shown that drumming is carried out almost exclusively by males, with duration and frequency falling after the main period of egg laying (Green in prep.) and ceasing after hatching (Tuck 1972). During this study the major period of egg-laying occurred in the first two weeks of May - the time of the first two census days, coinciding with the peak in early-morning registrations (Green 1985). Drumming decreased subsequently in almost all of Green's colour-marked males as incubation progressed, a drop detected in subsequent early-morning survey visits.

### Seasonal variation

The reduction in registrations during the season, and particularly in the frequency of drumming, indicates a seasonal trend in the detectability of Snipe. The decrease in drumming displays after the main laying period (the number of drumming males representing the number of pairs) means that population estimates based upon subsequent census visits would seriously underestimate the breeding population, unless there were to be wholesale re-nesting after flooding. This did not occur in the current study. For his survey areas, including the currently discussed area, Green (1985) noted that the peak density of drumming Snipe was very close to the estimated peak nest density. This peak was brief, with calculations of nest density progressively poorer if drumming numbers from later in the season were used to predict nest density (Green 1985).

In many other waders (Cramp and Simmons 1983), there are two peaks in detectability; the initial display period associated with territory definition and courtship, and a subsequent period when young are present. During this period adult waders are characteristically highly vocal and obtrusive. Unlike most waders, Snipe broods are split

Table 1. The relative frequencies of the behaviours of Snipe recorded on early-morning and late-morning visits to the study area.

Date	EARLY-MORNING						LATE-MORNING							
	Alarm %	Other Calls %	'Chipping' %	Drumming %	Total Sound %	Non Sound %	Number of Records	Alarm %	Other Calls %	'Chipping' %	Drumming %	Total Sound %	Non Sound %	Number of Records
1.5.84	15	13	22	31	81	19	59	55	0	20	10	85	15	20
14.5.84	10	3	23	58	87	13	31	20	0	7	7	34	66	15
29.5.84 a)	7	3	45	24	79	21	29	0	14	43	29	86	14	7
b)	12	6	6	47	29	88	17	21	0	64	7	92	8	14
13.6.84	23	3	54	17	97	3	35	57	0	0	14	71	29	7
25.6.84	27	9	9	23	68	32	22							
						Total	164						Total	63

Note: The census area was partially flooded on 29 May. The area covered during the early-morning visit (a) was greater than in the later-morning visit. Results (b) are given for the area which it was possible to cover on both visits.

between adults and aggressive vocal displays in defence of chicks are rare (Tuck 1972). The second peak in detectability, recorded in most wader species as adults defend their young, is absent. This means that population estimation, and territorial plotting, will be affected by the stage in the season when surveys are carried out, as well as by the time of day.

#### Census implications

Diurnal and seasonal trends in bird behaviour suggest that population censuses must take both into account. Of particular concern was the diurnal disparity between population estimates. The first two early-morning surveys indicated 16-19 males on the washland, yet only 1-2 according to late-morning surveys. Working on part of the survey area, Green (in prep.) had 8 colour-marked territorial males and three additionally known territorial males. Eight of these were recorded on the first early-morning visit, compared with only two later that day. This indicates that the estimated population of 16-19 males for the whole surveyed tract is more realistic than the 2 pairs indicated by survey visits later in the day. In almost all cases, drumming activity in marked males dropped as egg laying proceeded, further reducing the precision of population estimates.

#### Why early morning censuses?

Sutton (1923), Tuck (1972) and Reddig (1978) all record a peak in Snipe drumming displays at dusk, with drumming continuing into darkness and throughout moonlit nights, with crepuscular activity common throughout the year. Most of the Snipe's feeding and social interactions are carried out in the hours between early dusk and late dawn. It follows that one would expect to detect most individuals during this period, and not later in the day when feeding is infrequent and most males are roosting (Tuck 1972).

In most bird species territorial display occurs prior to, and at the end of, the main period of activity (Krebs 1977). This usually means dawn and dusk, when conditions for vocalising are best, with minimal background noise and relatively stable air masses acting to reduce attenuation. For a crepuscular and strongly vocally-displaying species such as Snipe, twilight conditions are ideal for advertising over a large distance. However, they present problems for censusing. Given the wide diameter (<200 m) of a drumming bird's path, and the problems of individual detection with several birds in the air at once, censusing any more than a small area in failing light is inefficient. Dawn censusing allows sight of individual birds whilst drumming is at a peak, before decreasing in intensity for the rest of the day.

#### SUMMARY

Snipe were censused on 5 days between 1 May and 25 June 1984 on an area of washland in Cambridgeshire, England. On each day the area was visited twice, once after dawn and 3-4 hours after the end of the previous visit. All Snipe observed were mapped. Behaviours of Snipe were compared between visits on the same day,

and over the course of the season. Although the proportion of non-vocal and vocal records varied little between times of day, there was a significant decrease in the number of drumming birds in the early morning during the course of the season. This was not shown by visits later in the day. Studies of colour-marked birds showed that the reduction in drumming was related to the onset of egg-laying and incubation. The efficiency of territory detection was far higher on early than later visits. The implications of diurnal and seasonal variation in Snipe displays are discussed.

#### ACKNOWLEDGEMENTS

Thanks are due to Dr. R.E. Green for help, encouragement, criticism of the manuscript and early sight of his records; to the RSPB for site access; to Dr. P. Kearns, C. Gailey, T. Dee and J. Spencer for help with fieldwork; and to Drs. L.A. Batten, M.W. Pienkowski, D.R. Langslow, F.A. Clements and a reviewer for their constructive comments. This study formed part of Project No. 406 of the Nature Conservancy Council's Commissioned Research Programme.

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