Observations on the diurnal rhythm of Greenland Wheatears *Oenanthe oe. leucorrhoa* Gm. in continuous daylight

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(Med et dansk resumé: Iagttagelser af døgnrytmen hos Grønlandsk Stenpikker under højarktiske lysforhold)

Dedicated to Dr. phil. Finn Salomonsen on the occasion of his seventieth birthday, 31st January 1979

INTRODUCTION

Studies on the Wheatear *Oenanthe oenanthe* are few (Mildenberger 1943, Ruthke 1954, Berck 1961, Menzel 1964, Rjabow 1965 and Panow 1974) and the diurnal rhythm of this species has only been studied by Peiponen (1970).

In 1974 we participated in The Joint Biological Expedition to NE-Greenland arranged by the Dundee University and The British Trust for Ornithology. We spent nearly two months (25 June to 16 August) at Mestersvig, Scoresbyland (72.16 N, 23.55 W), where our main aims were to study the diurnal rhythm of the Wheatear and the Snow Bunting *Plectrophenax nivalis,* and to make a detailed study of the breeding of the Arctic Tern *Sterna paradisaea* (Green and Greenwood, in print).

Investigations on the day and night activity of passerines in 24 hours daylight are few (Karplus 1952, Armstrong 1954, Wagner 1958, Hoffmann 1959, Haarhaus 1968, Hussell 1972, Lennerstedt 1973, Kruell 1976, Andersson *et al.* 1978), but give interesting possibilities for studying the general trends of clutch size in relation to utilization of the increased potential activity period with increasing latitude. The factors determining the period of activity are not known. In this study we have analyzed the influence of temperature, light intensity and invertebrate activity, and made a comparison of the resting periods of the Snow Bunting and the Wheatear.

METHODS

During the days 10–11, 13–14, 16–17 and 19–20 July continuous observations were made at a Wheatear's nest in the Nyhavn Hills at Mestersvig. The nest was hidden between rocks and we could not see into it to record hatching and number of young. However, the birds already attended the nest on 26 June, a piece of an eggshell was found just outside the nest on 10 July, and the young first left the nest on 24 July. The nestling period is 12–15 days according to Witherby *et al.* 1938, so hatching probably occurred around 9 July. During the observation periods, ground-temperature and air-temperature 1 m above the ground was automatically measured every 30 min. with a microthermistor (Grant), and light intensity was measured every 60 min.

To study variations in invertebrate activity 10 pitfall traps were set in a single line and 2 yellow trays placed amongst *Vaccinium* and *Dryas* about 50 m from the nest. The pitfalls contained phenyl mercuric acetate solution and the trays contained water with a little soap added in each case to reduce surface tension. These traps were emptied and the different insects and spiders counted and preserved at intervals of 2 hours. The majority of the catch comprised Diptera in the water trays, so these alone have been used as an index of invertebrate activity.

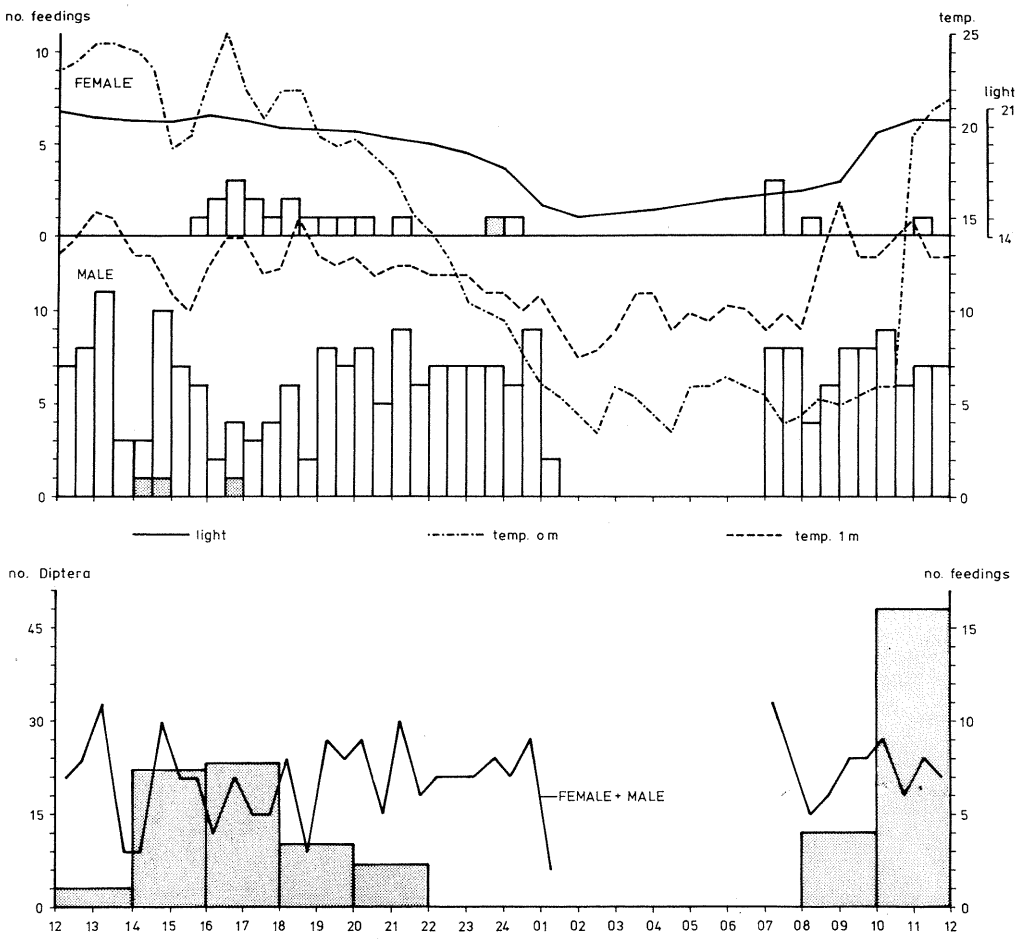

Fig. 1. Wheatear feeding activity with 1–2 day old nestlings. The upper and middle histograms show the number of visits made to the nest with food by female and male, respectively. The shaded portions of the columns indicate occasions on which a faecal sac was removed. The lower histogram shows the number of Diptera caught in pitfall traps and trays. The superimposed line shows the combined activity of the two birds. The lines on the upper and middle diagrams show illuminance, temperature at ground level, and temperature 1 m above the ground.

Stenpikkernes fodringsaktivitet med 1–2 dage gamle unger. Det øverste og mellemste histogram viser antallet af henholdsvis hunnens og hannens fodringsbesøg. De skraverede dele af søjlerne angiver besøg ved hvilke forældrene fjernede ekskrementer. Det nederste histogram viser antallet af tovingede insekter som i samme periode blev fanget i de opstillede fælder. Den indsatte kurve viser magernes kombinerede aktivitet. Endelig er belysning, temperatur ved jordoverfladen og i 1 meters højde angivet i det øverste og mellemste diagram.

RESULTS

The feeding activity patterns of the Wheatears are shown in Figs. 1–4, in relation to temperature, light intensity, and invertebrate (Diptera) activity.

The number of visits made by the two birds on the four days of observation were 23, 83, 152 and 156 (female), and 235, 233, 165 and 263 (male). Thus, not only were the chicks fed more often as they grew older, but the relative contribution of the two parents changed. In the first days after hatching the female spent most of her time brooding the nestlings and therefore contributed very little to the total amount of food brought in. On 10–11 July she brooded the nestlings for about 80% of her time, on the 13–14 July about 55%. She even slept in the

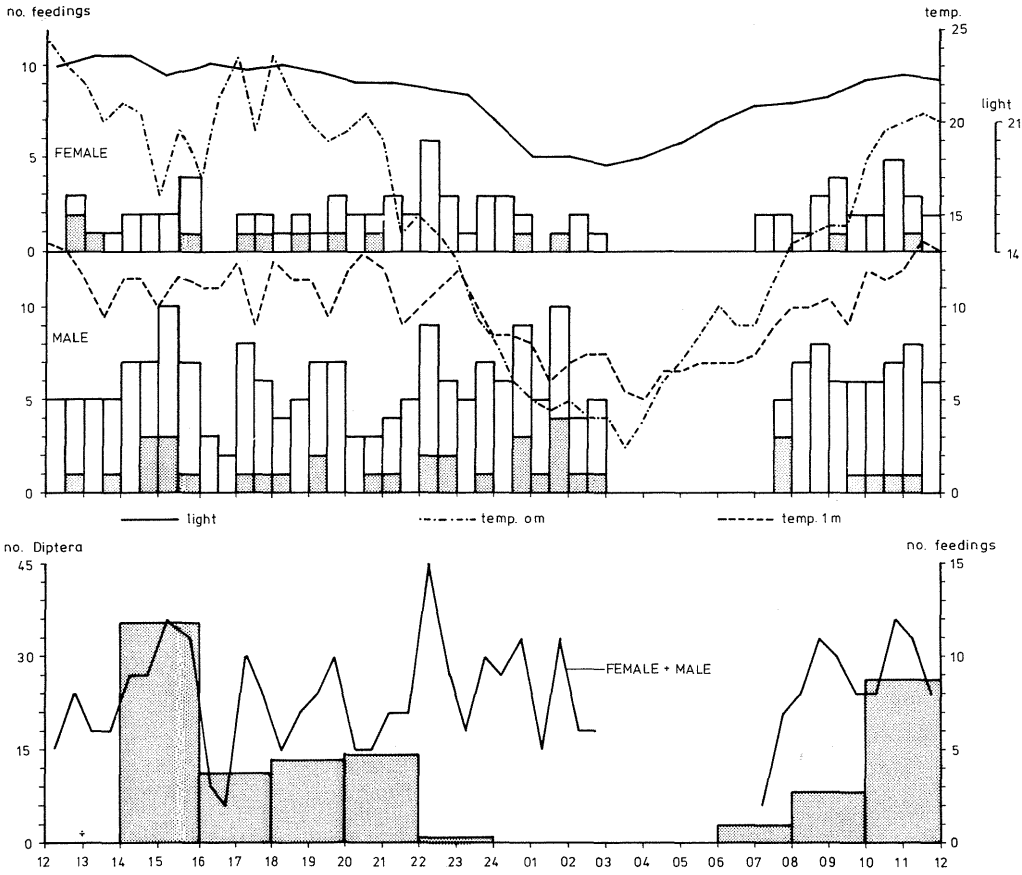

Fig. 2. Wheatear feeding activity with 4–5 days old nestlings. Details as in Fig. 1.
Stenpikkernes fodringsaktivitet med 4–5 dage gamle unger. Se tekst til fig. 1.

nest on these two nights. On 16–17 and 19–20 July she neither brooded the nestlings nor slept in the nest. We did not manage to find out where the female roosted when she did not stay overnight in the nest, and we did not discover the roosting site of the male neither.

Every night the Wheatear male and female had a distinct period of inactivity (Table 1). This lasted on average from 02.39–07.25, a mean period of 4 h 46 min, somewhat shorter than it must be in temperate parts of the species' range. On average, the male had its

Table 1. Periods of inactivity in Wheatears
Stenpikkerens inaktivitetsperioder.

Date	Male			Female		
	Start	End	Duration *Varighed*	Start	End	Duration *Varighed*
11 July	01.45	06.34	4h 49 min	00.09	06.27	6h 18 min
14 July	02.57	07.45	4h 48 min	03.25	07.14	3h 49 min
17 July	02.55	08.10	5h 15 min	02.28	06.43	4h 15 min
20 July	03.53	08.10	4h 17 min	03.41	08.19	4h 38 min
Average	02.53	07.40	4h 47 min	02.26	07.11	4h 45 min

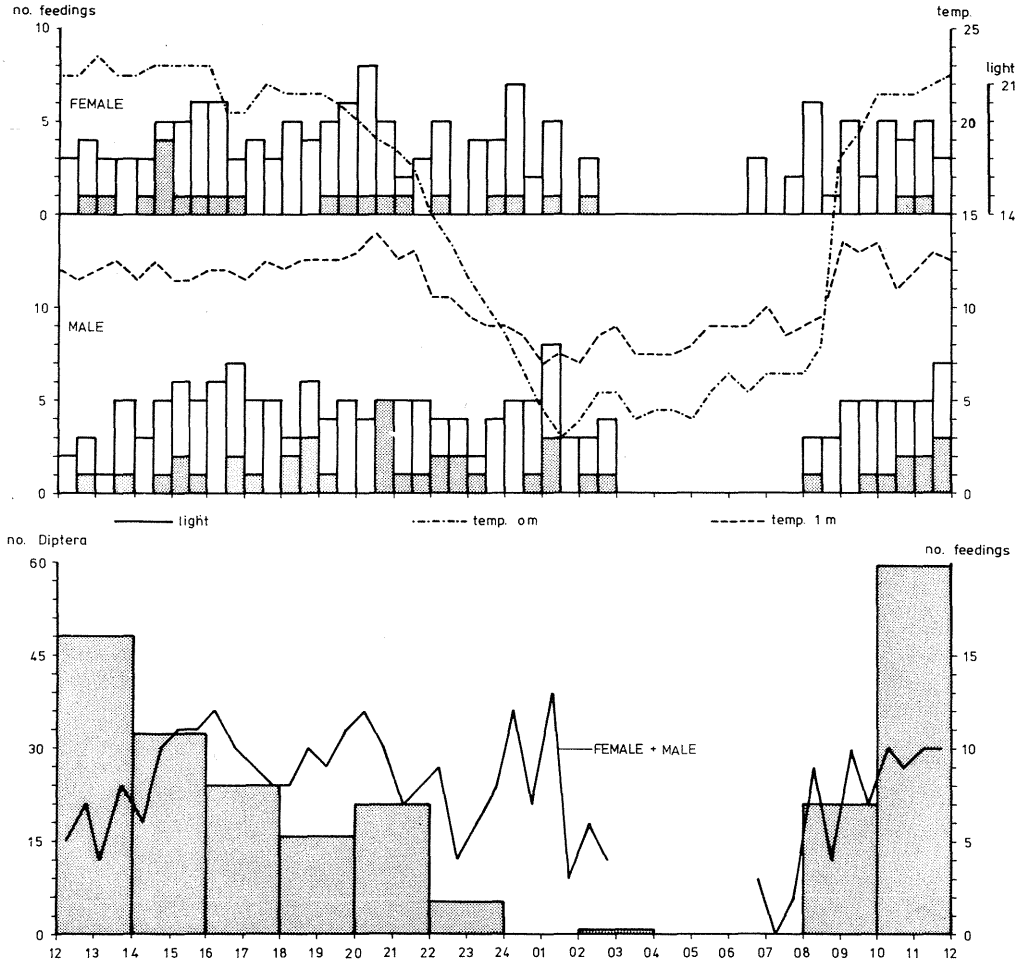

Fig. 3. Wheatear feeding activity with 7–8 days old nestlings. Details as in Fig. 1.
Stenpikkernes fodringsaktivitet med 7–8 dage gamle unger. Se tekst til fig. 1.

inactive period about half an hour later in the day than the female, but the difference is not significant (t-test for paired comparisons: $t_3 = 1.8$, $p \sim 0.2$). The mean lengths of the inactive period of the two sexes differed by only 2 min. The inactive period was earlier in the day when the nestlings were small and tended to get later through the ensuing periods of observation, though irregularly so for the female (correlation coefficients between mid-point of inactive period and date: for male, $r = 0.94$, $p<0.05$; for female, $r = 0.82$, $p<0.1$). This tendency was not correlated with changes in temperature, light, or activity of Diptera.

DISCUSSION

The factors determining the beginning and the end of the inactive period are obscure. Generally, the inactive period begins at low temperatures and illuminances but, during the inactive period, both temperature and light increase and the activity of the birds begins at higher values of temperature and light. The inactive period coincides with the inactive period of the Diptera, but it must be emphasized that Diptera constitute only a minor part of the food of the Wheatears. As far as we were able to observe in our 25×60 telescope, at least 90% of the food brought to the nest consisted of lepidopterous larvae, tipulid larvae and spiders, the spiders being less important than the larvae.

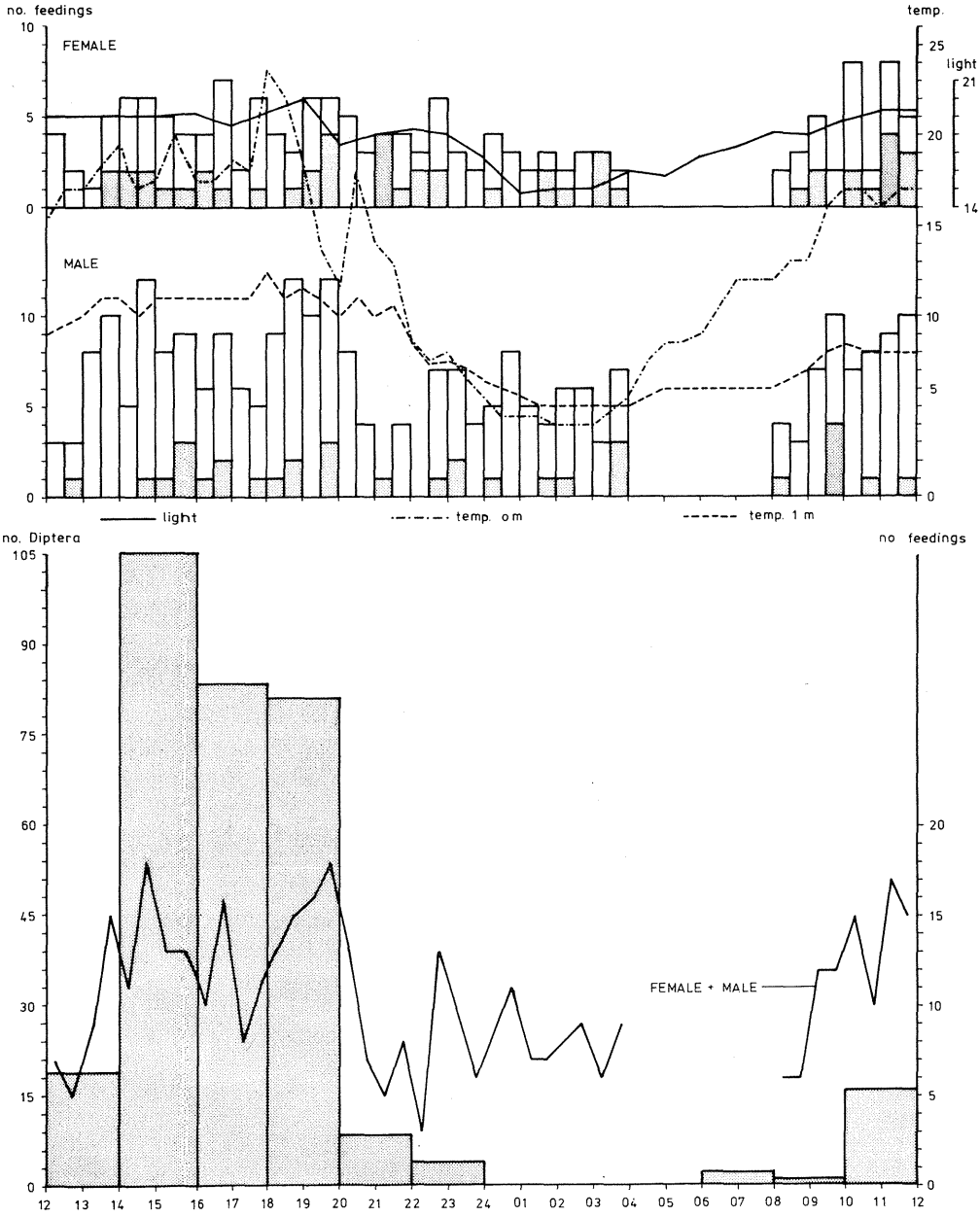

Fig. 4. Wheatear feeding activity with 10–11 days old nestlings. Details as in Fig. 1.
Stenpikkernes fodringsaktivitet med 10–11 dage gamle unger. Se tekst til fig. 1.

At a nest watched for six days at Kilpisjärvi in subarctic Finland (69° N, 20° 50'E), activity was at a minimum between 03.00 and 06.00 (Peiponen, 1970). The inactive period was apparently shorter than at the nest we observed. This is interesting but, of course, the comparison is based on only a single pair at each locality, and the Finnish birds may have been feeding more chicks.

It is remarkable that the inactive period for the Wheatears was 2–3 hours later in the day than for the Snow Buntings watched at the same time (see Fig. 5). On average, the length of the inactive periods of Wheatears and Snow

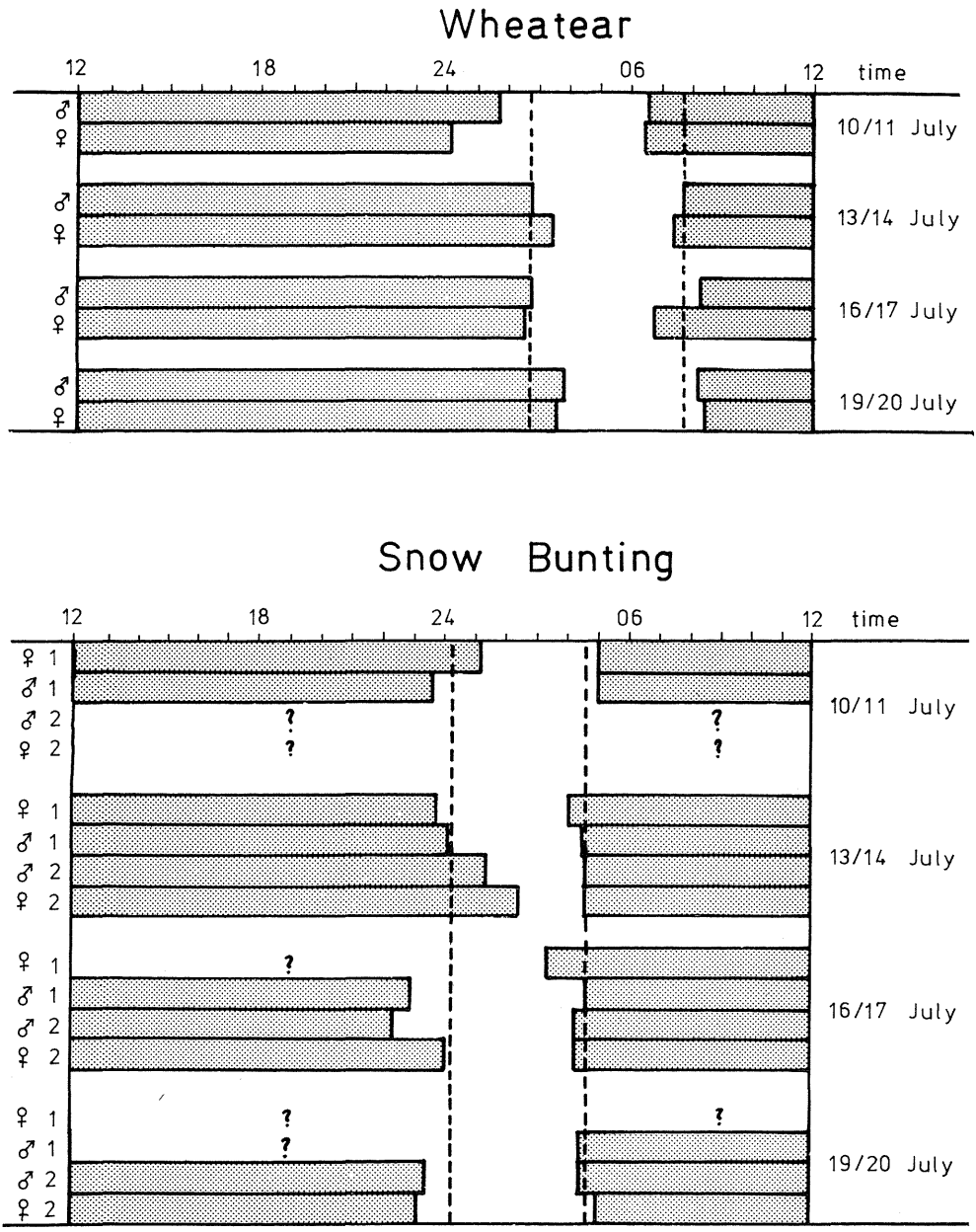

Fig. 5. Wheatear and Snow Bunting feeding activity. The shaded bars indicate periods in which the bird was visiting the nest. The dotted lines indicate the average limits of the inactive period in each species. Snow Bunting pair 1 was nesting in the same scree as the Wheatears. Pair 2 nested on Langdyssen, about 2 km to the east.

Fodringsaktiviteten hos Stenpikker og Snespurv. De skraverede søjler angiver perioder, i hvilke forældrefuglene fodrede eller opholdt sig i reden. De stiplede linjer angiver de to arters gennemsnitlige begrænsninger af aktivitetsperioderne. Snespurvepar nr. 1 ynglede i samme klippeparti som Stenpikkerne, mens Snespurvepar nr. 2 ynglede på Langdyssen, ca. 2 km mod øst.

Buntings were the same, Differences in the composition of food items brought to the nestlings of the two species might be an explanation of the different time of the inactive periods, but we are not able to demonstrate this, as we have examined the composition of the food thoroughly only in Snow Bunting nestlings. However, feeding during the late hours of the evening has been observed in the Wheatear *Oe. oe. oenanthe* in Germany (Mildenberger 1943, Berck 1961). The different methods by which the two species hunt their prey may also contribute to the difference in inactive periods, and interspecific competition may play a role.

According to the egg collections in Zoological Museum, Copenhagen, the clutch-size of Wheatears from Greenland is not significantly larger than clutches from Denmark. The prolonged feeding period of Wheatears in the Arctic as compared to those breeding at lower latitudes might be necessary due to differences in supply and availability of food.

ACKNOWLEDGEMENTS

We are very grateful to dr. Finn Salomonsen, who made it possible for us to join The Dundee University Expedition 1974, which was supported by the Royal Society, Royal Geographic Society, British Ornithologists' Union, British Trust for Ornithology, The Carnegie Trust for the Universities of Scotland, and many others fully acknowledged in the expedition report (Green and Greenwood, in print).

DANSK RESUMÉ

Iagttagelser af døgnrytmen hos Grønlandsk Stenpikker under højarktiske lysforhold.

I 1974 deltog vi i en engelsk ekspedition til Nordøstgrønland. Vi tilbragte næsten to måneder i Mestersvig med studier af døgnrytmen hos Stenpikker og Snespurv, samt ynglebiologiske undersøgelser af Havternen.

Kun få har beskæftiget sig med undersøgelser af døgnrytmen hos spurvefugle, der i yngletiden har mulighed for at være i aktivitet gennem hele døgnet. De faktorer, der er bestemmende for fuglenes aktivitet, er ikke kendte. Vi har analyseret temperaturens, lysintensitetens og insektaktivitetens indflydelse på Stenpikkerens døgnrytme.

Et par Stenpikkere blev iagttaget fra skjul i 24 timers perioder, mens de havde unger. Samtidigt blev jordoverfladetemperatur, lufttemperatur i 1 m højde og lysintensitet målt. Insekternes aktivitet blev bestemt ved antallet af fangne insekter i to timers perioder.

Stenpikkernes fodringsaktivitet fremgår af figs. 1–4. Det ses bl.a. af disse, at ungerne fodres tiere jo ældre de bliver, ligesom de to magers fodringsmønster ændres. Lige efter ungernes klækning tilbringer hunnen megen tid i reden for at holde ungerne varme, ligesom hun overnatter i reden. Senere bringer hun næsten lige så megen føde til reden som hannen og overnatter ikke i reden.

Det viste sig, at Stenpikkerne havde en inaktivitetsperiode (tabel 1) hver nat på gennemsnitligt 4 timer og 46 minutter. Også her observeredes en kønsforskel, idet hannens inaktivitetsperiode startede ca. en halv time senere end hunnens. Inaktivitetsperioden blev forskudt til senere på dagen jo ældre ungerne blev. Denne tendens var ikke korreleret med forskelle i temperatur, lys eller insektaktivitet.

Det var ikke muligt at fastslå, hvilke faktorer der var bestemmende for inaktivitetsperiodens begyndelse og slutning. Der synes at være en sammenhæng med insektaktiviteten, men det må påpeges, at de tovingede insekter kun udgør en ringe del af den føde, som bringes ungerne. Det hyppigste fødeemne var sommerfuglelarver, hvis aktivitet vi ikke var i stand til at måle.

I fig. 5 sammenlignes de inaktive perioder hos Snespurv og Stenpikker. Det ses at længden af disse perioder er omtrent lige lange, mens tidspunktet for start og slutning er forskellige. Dette kunne hænge sammen med forskelle i fødevalg og fødesøgningsadfærd. Snespurven samler ofte kuldelammede insekter, mens Stenpikkeren kun samler aktive insekter.

Sammenlignet med mere sydlige bestande er Stenpikkerens aktivitetsperiode forlænget i Arktis. Dette er måske en nødvendighed på grund af fødemængden og vanskeligheden ved at finde føden.

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