

# Diurnal and seasonal variation in song activity

## Results from a Danish survey covering 20 species

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(Med et dansk resumé: Døgn- og årstidsvariationer i sangaktivitet)

### Introduction

Variation in song activity during the day and during the year is one of the many interesting features of birds. Our knowledge of when bird song starts in the morning and ends at night is fairly good, and this can also be said about the beginning and the end of the song season. This is merely qualitative knowledge, however.

Only few have used quantitative methods in their investigations of song activity. For eight of the species covered in this study no publications have been found at all. Among these are very common species such as Lapwing, Skylark, Meadow Pipit, Sedge Warbler, Reed Warbler, Whitethroat and Greenfinch. This investigation has been made to fill this gap in our knowledge.

### Material and methods

Registration of song activity was made during 1993-1997 at four sites in Denmark. Site 1 is located in an area with old gardens with tall trees in a Copenhagen suburb. Site 2 is a valley with meadows surrounded by fields in southeastern Zealand. Site 3, situated close to site 2, is farmland with cereals, sugar beets and pasture grazed by cows. Site 4 is a big salt marsh in the southern part of the island Læsø.

At each site all registrations were made from the same counting point. In each month throughout the year (except November-December at site 2 and 3, and February-March and October-November at site 4) counts were made for ten minutes during every hour of the day, from one hour before sunrise to one hour after sunset. For each minute it was recorded for all species whether they sang, and if not, whether they were recorded in an other manner. Hence, a record is a registration of song or

other behaviour during one minute for one species at one site; a song record is a record with song. At each site counts were only made once for each month of the year during the 5-year study period. In total, counts were made during 644 hours, covering between 9 (December) and 24 hours (June) per month and site.

For each species song is defined in accordance with the relevant definitions in Cramp & Simmons (1983), Cramp (1985, 1992), Cramp & Perrins (1993, 1994a, 1994b).

The weather's influence on recorded activity was minimized by making registrations in "fine weather" only, i.e. weak wind (mean 1.7 Beaufort, only 16 census units with more than 3 Beaufort), and no precipitation in all but 30 census units. All registrations were made by the author, so there was no variation due to different observers. Most registration days fell within the first half of each month.

When comparing song activity in different months, registrations from the same hours in relation to sunrise and sunset are used for all months. These hours are the hour before sunrise, the hour with sunrise and the next five hours, the registrations at noon and then the five hours before sunset, the one with sunset and the hour after sunset. This number of hours is chosen to get the biggest possible range of hours to compare. With a higher number, too many months would have too few hours with registrations; by using 15 hours as described, only the period from October to March has too few. The chosen hours are also used to calculate a summed diurnal variation for the entire song period.

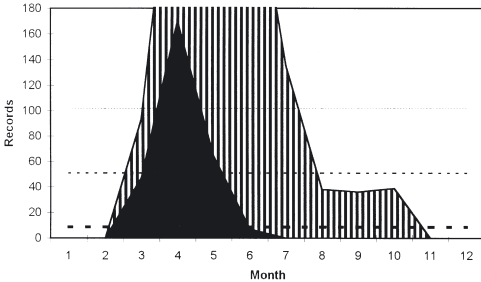


Fig. 1. Seasonal variation in song activity of Lapwing. Song is shown in black, other behaviour with vertical hatching. The upper dotted line indicates 60% of maximum song activity, the line in the middle 30%, and the lower line 5% of maximum. The vertical axis shows the number of records, the horizontal axis the months from January to December.

*Årstidsvariation i sangaktivitet hos Vibe. Sang vises med sort, anden adfærd med lodret skravering. Den øverste punkterede linje angiver 60% af maksimal sangaktivitet, den midterste 30%, og den nederste 5% af maksimum. Den lodrette akse viser antallet af registreringer, mens den vandrette akse viser måneden*

## Results

The results for each species are presented as graphs showing the variation in song activity during the year and during the day. To indicate whether a species is present in periods with no song recorded, registration of other types of behaviour is also included in the graphs. The graphs are supplemented with brief summaries.

The song activity is categorised according to the maximum number of records in any month/hour. High activity is defined as more than 60% of the maximum, medium activity means 30-60%, and low activity 5-30%.

The purpose of the graphs is to give a general picture of the variation in song activity. Graphs based on a high number of records are supposed to give a more accurate picture than graphs based on a low number. Accordingly, criteria have been set out for the number of records required for each type of graph. The criteria are based on the experience, that "fairly" smooth graphs give a "fairly" good picture of the variation. For the two-dimensional graphs 30 records in two periods or 15 in four periods are required. For the three-dimensional graphs the requirements are 40 in two periods or 20 in four periods.

### Lapwing *Vanellus vanellus* (Fig. 1-2)

The species is an abundant breeding bird at site 2 and scarce at site 3 and 4. The total number of song records is 321.

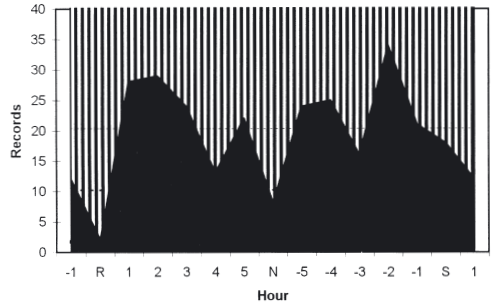


Fig. 2. Diurnal variation in song activity of Lapwing. Song is shown in black, other behaviour with vertical hatching. The upper dotted line indicates 60% of maximum song activity, the line in the middle 30%, and the lower line 5% of maximum. The vertical axis shows the number of records, the horizontal axis the hour relative to sunrise (R), noon (N) and sunset (S).

*Døgnvariation i sangaktivitet hos Vibe. Sang vises med sort, anden adfærd med lodret skravering. Den øverste punkterede linje angiver 60% af maksimal sangaktivitet, den midterste 30%, og den nederste 5% af maksimum. Den lodrette akse viser antallet af registreringer, mens den vandrette akse viser tiden i timer, relativt til solopgang (R), middag (N) og solnedgang (S).*

The song season starts with low activity in March but changes to high activity in April, where it peaks. In May song frequency is medium and the song season peters out, although sporadic song is heard in June. The species sings throughout the day with medium to high song frequency. The 24-hour surveys in June reveal that the species sings all through the night too, but with low frequency.

No information about seasonal or diurnal variation in song activity has been found in the literature.

### Snipe *Gallinago gallinago* (Fig. 3-4)

The species is an abundant breeding bird at site 2. The total number of song records is 164.

The song season starts in April with high activity. In May, activity decreases to medium, only to increase again and peak in June. Song frequency is medium in July by which month the song season ends. The song frequency is high in the hour before sunrise and from two hours before sunset, medium in the morning, and medium to low in the afternoon. The 24-hour surveys in June reveal that song activity remains high for two hours after sunset, after which the species is silent until one hour before sunrise.

The diurnal variation has been studied by Göransson & Karlsson (1976) in southern Sweden in May-June. The pattern found was similar to this study, but with low song activity during the night.

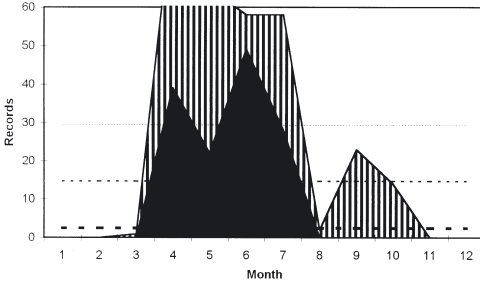


Fig. 3. Seasonal variation in song activity of Snipe. See Fig. 1.  
*Årstidsvariation i sangaktivitet hos Dobbeltbekkasin. Se Fig. 1.*

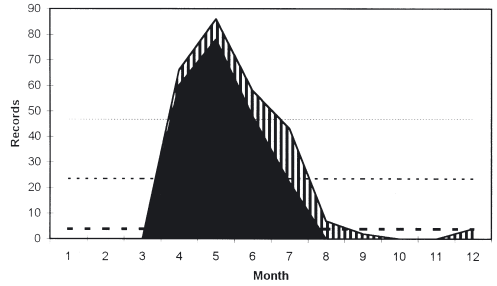


Fig. 5. Seasonal variation in song activity of Curlew. See Fig. 1.  
*Årstidsvariation i sangaktivitet hos Stor Regnspove. Se Fig. 1.*

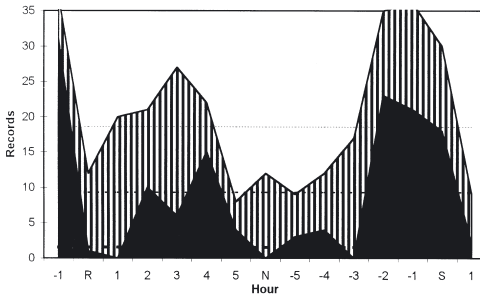


Fig. 4. Diurnal variation in song activity of Snipe. See Fig. 2.  
*Døgnvariation i sangaktivitet hos Dobbeltbekkasin. Se Fig. 2.*

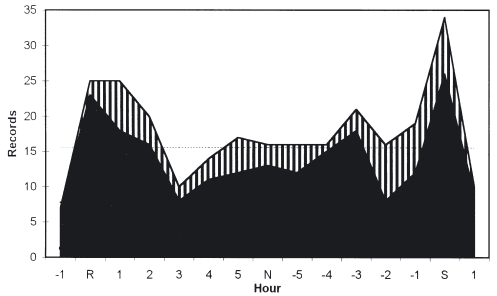


Fig. 6. Diurnal variation in song activity of Curlew. See Fig. 2.  
*Døgnvariation i sangaktivitet hos Stor Regnspove. Se Fig. 2.*

**Curlew *Numenius arquata* (Fig. 5-6)**

The species is a rather common breeding bird at site 4. The total number of song records is 261.

The song season begins with high activity in April; activity peaks in May, declines to medium in June and ends in July. The species starts to sing with low activity an hour before sunrise. The activity peaks at sunrise and remains high for the next two hours. During the rest of the day activity is medium except for an evening peak at sunset; it ends one hour after sunset. The 24-hour surveys in June reveal that the species does not sing during the rest of the night.

No articles about seasonal or diurnal variation in song activity have been found.

**Woodpigeon *Columba palumbus* (Fig. 7-9)**

The species is a very common breeding bird at site 1 and rather common at site 2 and 3. The total number of song records is 1018.

After sporadic song in December, the song season starts in January with low activity. From February to April the activity is medium, but steadily increasing. From May to September it is high,

with peaks in May and August. The song period ends in September.

Song is sporadic an hour before sunrise. At sunrise and for the next two hours, song activity is high, with a peak one hour after sunrise. There after the activity gradually declines, being medium 3-5 hours after sunrise and low from noon to five hours before sunset. Song activity then gradually increases at medium level from four to three hours before sunset, and after an evening peak at high level two hours before sunset, activity remains high during the next hour, falls to medium level at sunset and peters out an hour after sunset. The 24-hour surveys in June reveal that the species does not sing during the rest of the night.

The 3D graph (Fig. 9) shows a very similar diurnal variation throughout the season, with a high but rather broad morning peak one hour after sunrise, a broad but slightly lower evening peak, and medium to low song activity during the rest of the day.

Previously, quantitative observations of diurnal and seasonal song variation in Woodpigeon have been reported by Klug-Andersen (1983), who

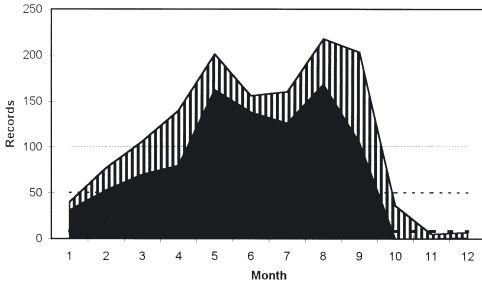


Fig. 7. Seasonal variation in song activity of Woodpigeon. See Fig. 1.  
*Årstidsvariation i sangaktivitet hos Ringdue. Se Fig. 1.*

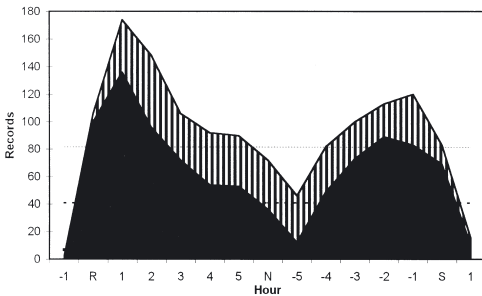


Fig. 8. Diurnal variation in song activity of Woodpigeon. See Fig. 2.  
*Døgnvariation i sangaktivitet hos Ringdue. Se Fig. 2.*

found a very similar pattern; the census area was in Denmark, but only the period from April to July was covered. Andersen (1992) measured seasonal variation in Denmark from March to August and found roughly the same pattern, except that high song activity was recorded already in April. Kayser (1984) studied song activity in Denmark throughout the year, revealing nearly the same pattern as in the present study. The song period started one month later in forest than in urban areas, and no peak in August was apparent. Slagsvold (1977) measured the variation from March to July in southern Norway; his data set was rather small but showed roughly the same pattern as the present study, except that the spring peak fell in April.

**Cuckoo *Cuculus canorus* (Fig. 10-11)**

The species is a rather common breeding bird at site 2 and scarce at site 4. The total number of song records is 208.

The song season is from May to July, with high activity in all months and a peak in June. The diurnal variation remains the same during May, June and July. The species begins singing with high song activity from an hour before until two

hours after sunrise, with a peak at sunrise. For the rest of the morning hours and during the afternoon song activity is low, apart from a peak with medium activity 4-5 hours after sunrise. From one hour before to one hour after sunset the song frequency is at medium; it peaks at sunset. The 24-hour surveys in June reveal that the species does not sing during the rest of the night.

A previous Danish study of seasonal song variation throughout the year (Kayser 1984) revealed exactly the same pattern as the present study. The diurnal variation was studied by Göransson & Karlsson (1976) in southern Sweden in May and June, showing a pattern very similar to that given here, including the peak five hours after sunrise, but also recording sporadic song throughout the night. Klockars (1941) recorded high song activity around midnight in Finland, but only in June. Palmgren (1932) studied variation in song activity in Finland during the second half of June, finding that the Cuckoo was a night singer, singing from 8 p.m. to 3 a.m. with only sporadic song during the day.

**Skylark *Alauda arvensis* (Fig. 12-14)**

The species is a very common breeding bird at site 3 and 4, and scarce at site 2. The total number of song records is 1833. No counts were carried out at site 4 in February and March. To adjust for this, figures from area 3 have been doubled for this

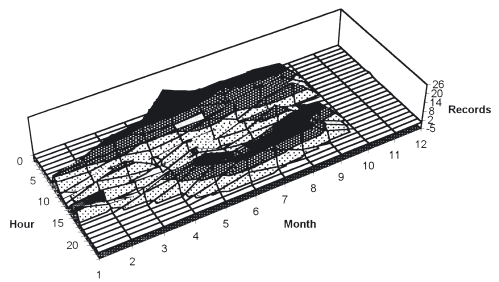


Fig. 9. Diurnal and seasonal variation in song activity of Woodpigeon. Low song activity is shown in white with black dots, medium activity in black with white dots, and high song activity in black. The vertical axis shows the number of records, while the two horizontal axes indicate hours of the day and months of the year.

*Døgn- og årstidsvariation i sangaktivitet hos Ringdue. Lav sangaktivitet vises med sorte prikker på hvid baggrund, medium aktivitet med hvide prikker på sort baggrund, og høj sangaktivitet med sort. Den lodrette akse angiver antallet af registreringer af sang, mens de to vandrette akser angiver timen og måneden.*

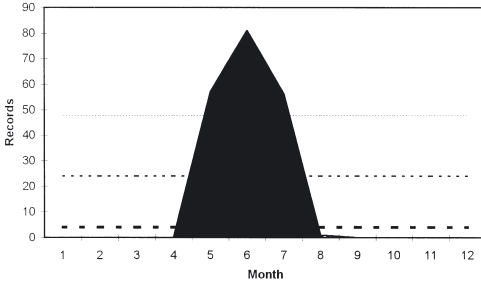


Fig. 10. Seasonal variation in song activity of Cuckoo. See Fig. 1.  
*Årstidsvariation i sangaktivitet hos Gøg. Se Fig. 1.*

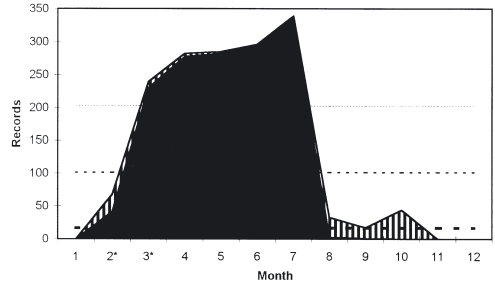


Fig. 12. Seasonal variation in song activity of Skylark. For meaning of the asterisks, see the text. See also Fig. 1.  
*Årstidsvariation i sangaktivitet hos Sanglærke. Se Fig. 1.*

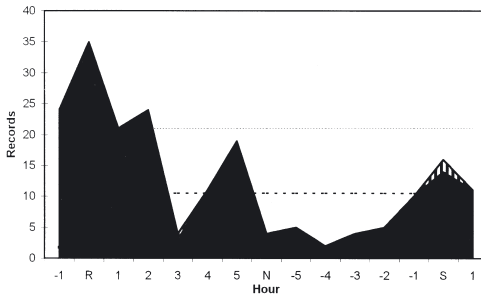


Fig. 11. Diurnal variation in song activity of Cuckoo. See Fig. 2.  
*Døgnvariation i sangaktivitet hos Gøg. Se Fig. 2.*

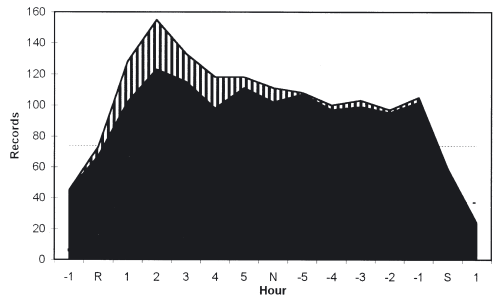


Fig. 13. Diurnal variation in song activity of Skylark. See Fig. 2.  
*Døgnvariation i sangaktivitet hos Sanglærke. Se Fig. 2.*

period; this is indicated by asterisks in Fig. 12 and 14.

The song season starts with low activity in February. From March to July activity is high, peaking in July, after which it ceases abruptly. Diurnal song activity starts with medium activity one hour before sunrise. After sunrise and throughout the day song activity is high, declining to medium at sunset and low one hour after sunset. According to the 24-hour surveys in June the species does not sing during the rest of the night. The 3D graph (Fig. 14) confirms that Skylarks after starting with low activity in February sing at high activity all through the day from March to July and thereafter stop.

No papers on seasonal or diurnal variation in song activity have been found.

**Meadow Pipit *Anthus pratensis*** (Fig. 15-16)

The species is an abundant breeding bird at site 2. The total number of song records is 271.

After being at medium level in March and April, song activity becomes high from May to July and then declines sharply to low levels in August

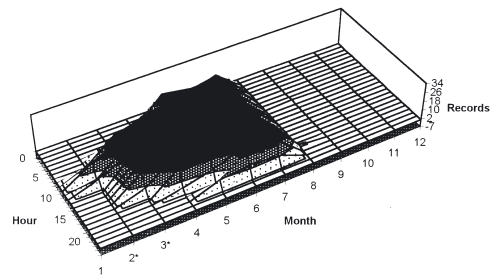


Fig. 14. Diurnal and seasonal variation in song activity of Skylark. For meaning of the asterisks, see the text. See also Fig. 9.

*Døgn- og årstidsvariation i sangaktivitet hos Sanglærke. Se Fig. 9.*

before it ends. Diurnal song activity starts at a high level at sunrise and continues so for the next three hours, with a peak one hour after sunrise. It declines to medium four hours after sunrise and reaches a minimum at a low level during the next hour. Activity is still low at noon but increases to medium level in the afternoon. From one hour before sunset to sunset the song activity is high

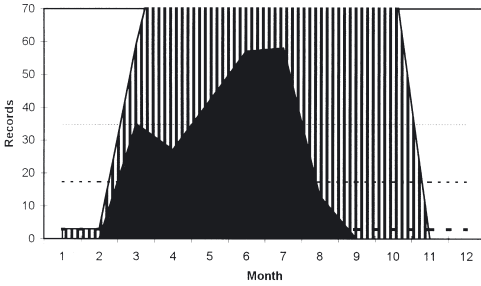


Fig. 15. Seasonal variation in song activity of Meadow Pipit. See Fig. 1.  
*Årstidsvariation i sangaktiviteten hos Engpiber. Se Fig. 1.*

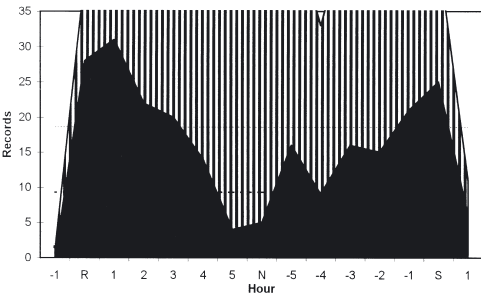


Fig. 16. Diurnal variation in song activity of Meadow Pipit. See Fig. 2.  
*Døgnvariation i sangaktiviteten hos Engpiber. Se Fig. 2.*

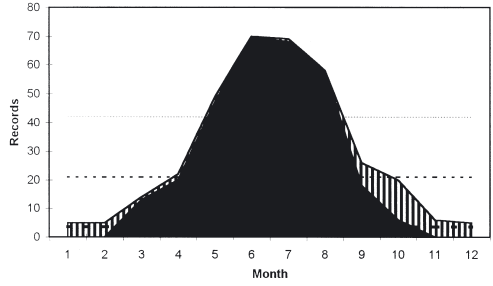


Fig. 17. Seasonal variation in song activity of Wren. See Fig. 1.  
*Årstidsvariation i sangaktivitet hos Gærdesmutte. Se Fig. 1.*

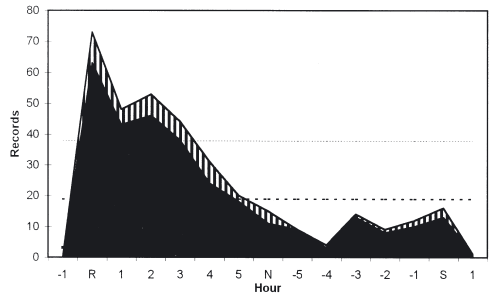


Fig. 18. Diurnal variation in song activity of Wren. See Fig. 2.  
*Døgnvariation i sangaktivitet hos Gærdesmutte. Se Fig. 2.*

with a peak at sunset; during the following hour the song activity again is low. The 24-hour surveys in June reveal that the species is quiet during the rest of the night.

No papers on seasonal or diurnal variation in song activity have been found.

**Wren *Troglodytes troglodytes*** (Fig. 17-18)

The species is a common breeding bird at site 1 and scarce at sites 2, 3 and 4. The total number of song records is 348.

The song season starts with low activity in March and April. From May to August song activity is high with a peak in June; the activity then peters out in September and October. Song was not formally recorded during the rest of the year, but sporadic song phrases were occasionally heard during the morning throughout the winter.

The species begins to sing at sunrise, the activity being at peak level from the start. High activity continues for three hours and thereafter falls during the morning, activity being medium four hours after sunrise and low for the rest of the day. Singing ceases at sunset.

Andersen (1992) studied seasonal variation in Denmark from March to August and found a very similar pattern, except that song activity was high already in April and low in August. Seasonal variation was studied by Kayser (1984) throughout the year, also in Denmark; he found nearly the same pattern as described from this study, but the song period continued at low activity level until December. Nilsson (1974) measured the variation from March to June in southern Sweden; his rather small data set showed roughly the same pattern as the present study. The diurnal variation in a previous Danish study (Klug-Andersen 1983) was similar to that given here.

**Robin *Erithacus rubecula*** (Fig. 19)

This species is a rather common breeding bird at site 1 and scarce at site 3. The total number of song records is 90.

The song period begins with low activity in April, increasing to medium in May and peaking at a high level in June; with this peak the song period comes to an abrupt end.



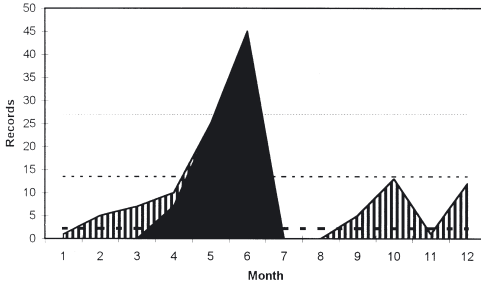


Fig. 19. Seasonal variation in song activity of Robin. See Fig. 1.

Årstidsvariation i sangaktivitet hos Rødhals. Se Fig. 1. Det viste mønster er muligvis ikke typisk, jf. Kayser (1994).

Andersen (1992) studied seasonal variation in Denmark from March to August and found a very similar pattern, although high song activity was still recorded in July. Seasonal variation in Denmark was also measured by Kayser (1984) and Klug-Andersen (1983). The patterns they found were nearly identical but differed from that found in this study: song activity was high from April to July with a peak in April, and low in October–November, with sporadic song during the rest of the year. Nilsson (1974) studied the variation from March to June in southern Sweden and found roughly the same pattern as Kayser (l.c.), as did Slagsvold (1977) in southern Norway in March–July. Thus, for some reason Fig. 19 seems not to give a typical picture of the seasonal variation in the song activity of Robin.

### Blackbird *Turdus merula* (Fig. 20–22)

The Blackbird is an abundant breeding bird at site 1, fairly common at site 2 and 3, and scarce at site 4. The total number of song records is 1118.

After sporadic song in February, the song season begins at low activity in March. In April, song activity reaches medium level, and in May–July it is high with a peak in June. In August song activity is low and petering out, although sporadic low-voiced song is still heard in October. The species starts to sing an hour before sunrise with medium song activity. At sunrise, song activity becomes high and attain a maximum, but one hour later it declines abruptly and remains at medium or low levels until after noon, when it begins gradually to increase so that it reaches a high level at sunset. There is an evening maximum one hour after sunset, after which the song ends. The 24-hour surveys in June reveal that the species is quiet the for rest of the night. Fig. 22 shows that Blackbirds early in the song season (April) almost exclusively

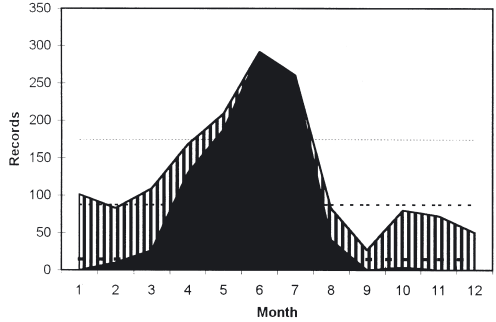


Fig. 20. Seasonal variation in song activity of Blackbird. See Fig. 1.

Årstidsvariation i sangaktivitet hos Solsort. Se Fig. 1.

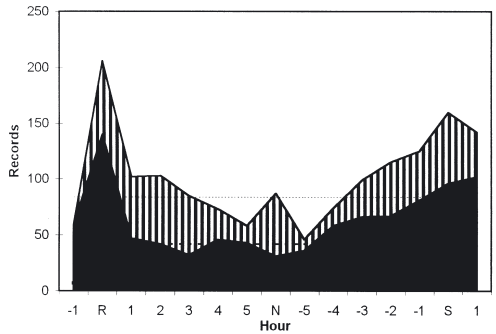


Fig. 21. Diurnal variation in song activity of Blackbird. See Fig. 2.

Døgnvariation i sangaktivitet hos Solsort. Se Fig. 2.

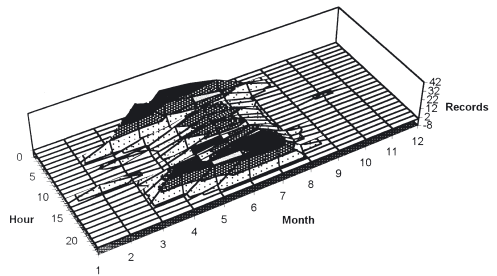


Fig. 22. Diurnal and seasonal variation in song activity of Blackbird. See Fig. 9.

Døgn- og årstidsvariation i sangaktivitet hos Solsort. Se Fig. 9.

sing around sunrise and sunset. In May and July, song activity during the day is low, while it is medium in June, and still exhibits maxima around sunrise and sunset. In August the pattern again is as early in the season, low song activity early in the

morning and late in the evening and no song during the day.

Previous Danish studies of diurnal and seasonal variation in song activity of the Blackbird are Klug-Andersen (1983; April to July only) and Andersen (1992; seasonal variation only). Both found patterns very similar to that described here. Seasonal variation in Denmark was also measured by Kayser (1984) throughout the year, again with results almost identical to those reported here, and neither did a comparison with Slagsvold's (1977) rather small data set from March-July in southern Norway disclose any important differences. Diurnal variation in May-June in southern Sweden was studied by Göransson & Karlsson (1976), whose results were in agreement with those from the present study. Klockars' (1941) results from Finland in May-June were more like the pattern noted in April in Denmark, perhaps owing to the late spring in Finland. Palmgren (1932), also Finland, likewise recorded a pattern in June similar to that from Denmark in April, with very little song during the day.

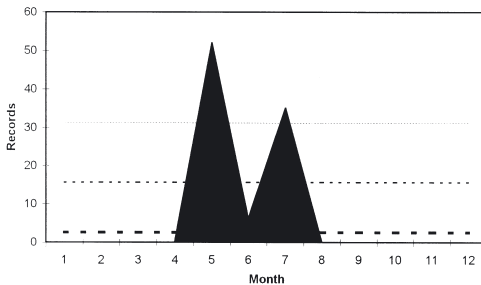


Fig. 23. Seasonal variation in song activity of Sedge Warbler. See Fig. 1.

*Årstidsvariation i sangaktivitet hos Sivsanger. Se Fig. 1.*

#### **Sedge Warbler** *Acrocephalus schoenobaenus* (Fig. 23)

This species is a scarce breeding bird at site 2. The total number of song records is 107.

The song season is from May to July, with song activity being high in May and July, but low in June.

No publications about seasonal or diurnal variation of song activity in the Sedge Warbler have been found.

#### **Reed Warbler** *Acrocephalus scirpaceus* (Fig. 24)

The Reed Warbler is a scarce breeding bird at site 2. The total number of song records is 154.

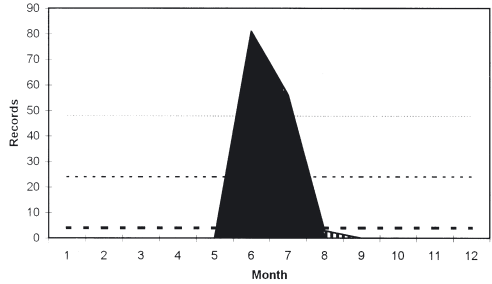


Fig. 24. Seasonal variation in song activity of Reed Warbler. See Fig. 1.

*Årstidsvariation i sangaktivitet hos Rørsanger. Se Fig. 1.*

The song activity is high in June and July, peaking in June. No song was recorded in May because the census took place early in the month, before the species had arrived.

No publications about seasonal or diurnal variation of song activity in the Reed Warbler have been found.

#### **Whitethroat** *Sylvia communis* (Fig. 25)

This species is a scarce breeding bird at site 2 and 3. The total number of song records is 134.

The song activity is high in June and low in July. The census work was carried out so early in May that no song was recorded in this month.

No publications about seasonal or diurnal variation of song activity in the Whitethroat have been found.

#### **Blackcap** *Sylvia atricapilla* (Fig. 26)

The Blackcap is a scarce breeding bird at site 1, 2 and 3. The total number of song records is 134.

The song season starts with high song activity in May, continues with low activity in June, and ends at medium level in July. Sporadic song is heard in August.

In Denmark, Klug-Andersen (1983) has previously studied seasonal song variation from April to July, Kayser (1984) throughout the year, and Andersen (1992) from March to August. Slagsvold (1977) studied song variation during March-July in southern Norway. All four authors found the song activity to be high from May to July, with a peak in June. The low song activity recorded in June in the present study thus appears to be atypical.

#### **Blue Tit** *Parus caeruleus* (Fig. 27)

The Blue Tit is a scarce breeding bird at site 1. The total number of song records is 91.



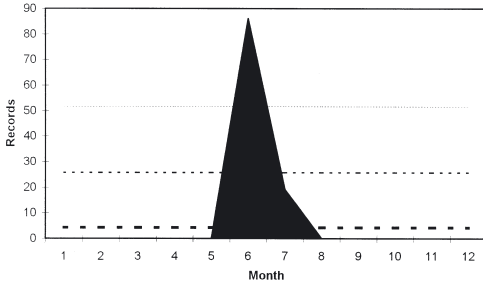


Fig. 25. Seasonal variation in song activity of White-throat. See Fig. 1.  
*Årstidsvariation i sangaktivitet hos Tomsanger. Se Fig. 1.*

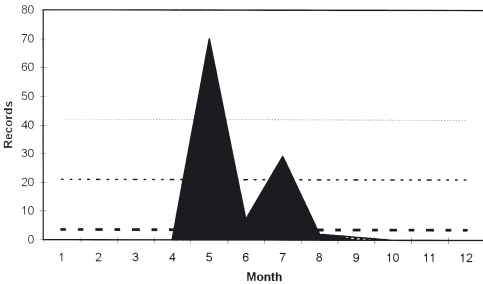


Fig. 26. Seasonal variation in song activity of Blackcap. See Fig. 1.  
*Årstidsvariation i sangaktivitet hos Munk. Se Fig. 1. Den lave sangaktivitet i juni er sandsynligvis atypisk.*

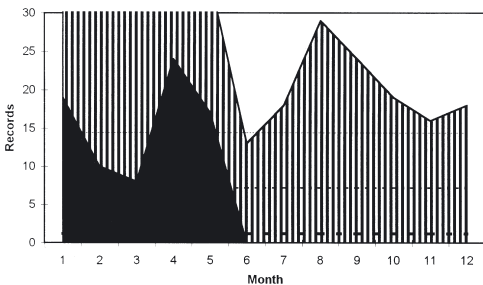


Fig. 27. Seasonal variation in song activity of Blue Tit. See Fig. 1.  
*Årstidsvariation i sangaktivitet hos Blåmejse. Se Fig. 1.*

The song season starts in January with high song activity, and after medium activity in February and March, the activity peaks in April. The song period ends in May, still with high activity.

Kayser (1984), in a full-year survey in Denmark, found exactly the same pattern as in the present study. While confirming that the song period ends in May, however, Andersen (1992), measuring seasonal song variation in Denmark from March to August, also found that low-level song activity was again heard in July.

**Great Tit *Parus major* (Fig. 28-29)**

The Great Tit is a common breeding bird at site 1 and scarce at site 2 and 3. The total number of song records is 300.

The song season begins at low activity in December. The activity increases to medium in January and high in February- May; in June it is low and peters out. Sporadic song is heard in October. The species begins to sing at sunrise, and activity remains high until four hours after sunrise; a maximum occurs at sunrise and again three hours after sunrise. Later in the morning and during the afternoon the song activity gradually falls to medium or low level until three hours before sunset, after which it indreases again but remain at medium level. Song activity ends soon after a maximum at sunset.

Diurnal and seasonal variation in song of the Great Tit were studied in England by Hinde (1952) during March-September, and in Denmark by Klug-Andersen (1983) during April-July. Seasonal variation was studied by Kayser (1984) throughout the year and by Andersen (1992) during March-August, both in Denmark. All these

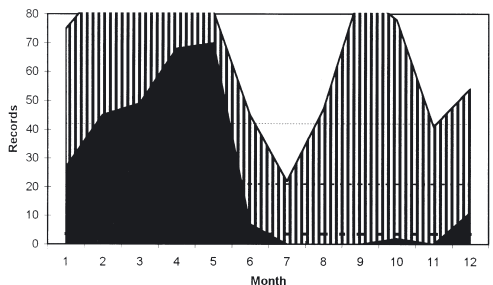


Fig. 28. Seasonal variation in song activity of Great Tit. See Fig. 1.  
*Årstidsvariation i sangaktivitet hos Musvit. Se Fig. 1.*

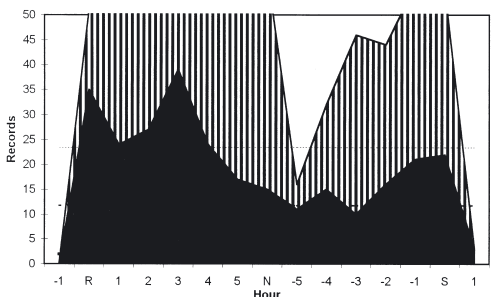


Fig. 29. Diurnal variation in song activity of Great Tit. See Fig. 2.  
*Døgnvariation i sangaktivitet hos Musvit. Se Fig. 2.*

studies gave results almost identical to those found in the present study. Slagsvold (1977), studying seasonal variation in southern Norway during March-July, found nearly the same pattern, but the song period continued to late June or early July. Even the diurnal variation found by Klockars (1941) in southern Finland in May-June, and by Klug-Andersen (1983) in Denmark, showed patterns very like that reported here.

### Chaffinch *Fringilla coelebs* (Fig. 30-31)

The Chaffinch is a scarce breeding bird at site 2, 3 and 4. The total number of song records is 152.

After sporadic song in February, the song season starts at low activity in March, followed by a marked peak in April. In May-June, song activity is low or medium, and from July it is low until it ends in September. However, despite the low song activity in May apparent from Fig. 30, the general impression from the study sites was that song activity was actually quite high. The September records were collected quite early in the month, which may explain why the song period continued into this month.

The species starts to sing one hour after sunrise, and high activity continues for the next four hours with a maximum two hours after sunrise. The activity then decreases and reaches a low level after noon, but increases again to medium level by three hours before sunset. Thereafter it decreases gradually, and at sunset only sporadic song is heard.

Seasonal song variation was studied in Denmark from April to July by Klug-Andersen (1983), throughout the year by Kayser (1984), and during March-August by Andersen (1992). Slagsvold (1977) made a similar study in southern Norway from March to July, and Bezzel (1988) completed a full-year study in southern Germany. All five authors found a song period lasting from March to

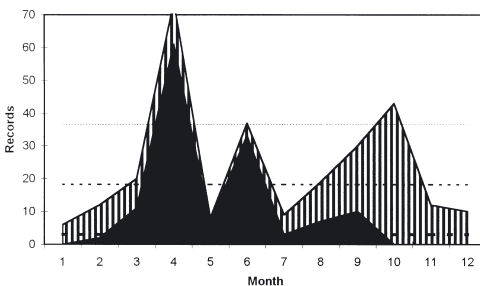


Fig. 30. Seasonal variation in song activity of Chaffinch. See Fig. 1.

Årstidsvariation i sangaktivitet hos Bogfinke. Se Fig. 1.

July, with high song activity during April-June and medium activity in March and July. In addition, Bezzel (l.c.) recorded low song activity in February and August, and sporadic song was heard in September. The diurnal variation was studied in southern Finland by Palmgren (1932), Klockars (1941), and Bergman (1953), who all found a pattern very similar to that described from the present study, as did Bezzel (l.c.) in Germany. In southern Sweden, Ehrström (1956) and Göransson & Karlsson (1976) found similar patterns.

### Greenfinch *Carduelis chloris* (Fig. 32-33)

This species is a common breeding bird at site 1 and scarce at site 2. The total number of song records is 345.

The song season starts in January at medium level, after which activity increases in February and March, although remaining at the medium level. Activity becomes high in April, medium again in May and June, and low in July and August, where the song ceases.

Song activity peaks one hour after sunrise after sporadic song at sunrise. The activity remains at or near the high level until noon. In the afternoon there is medium song activity until the last two hours before sunset, where it is high. By sunset the activity has fallen to a low level, and shortly afterwards it ceases.

No papers on seasonal or diurnal song activity variation in the Greenfinch have been found.

### Reed Bunting *Emberiza schoeniclus* (Fig. 34-35)

The Reed Bunting is a common breeding bird at site 2. The total number of song records is 547.

The song activity begins in March at medium level and is high from April to July, with a peak in June. No song is heard after July. The daily song period lasts from one hour before sunrise to one

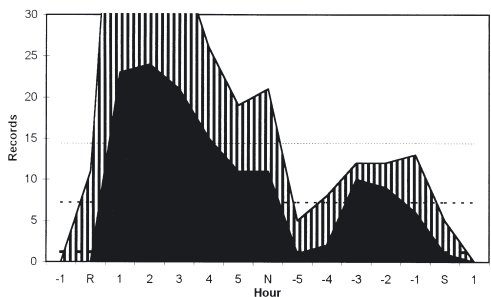


Fig. 31. Diurnal variation in song activity of Chaffinch. See Fig. 2.

Døgnvariation i sangaktivitet hos Bogfinke. Se Fig. 2.

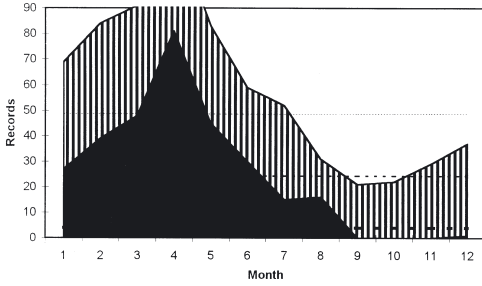


Fig. 32. Seasonal variation in song activity of Greenfinch. See Fig. 1.

Årstidsvariation i sangaktivitet hos Grønirisk. Se Fig. 1.

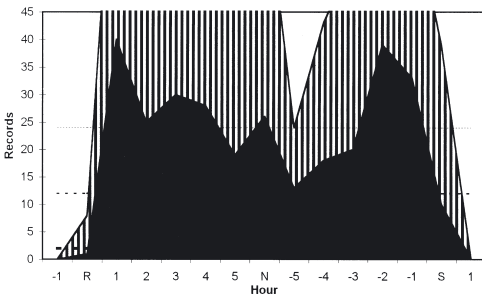


Fig. 33. Diurnal variation in song activity of Greenfinch. See Fig. 2.

Døgnvariation i sangaktivitet hos Grønirisk. Se Fig. 2.

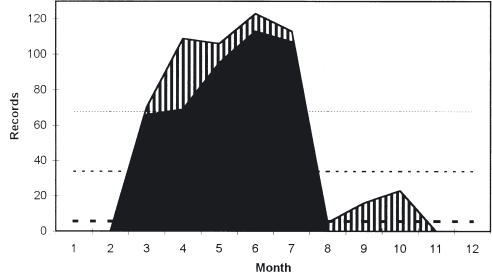


Fig. 34. Seasonal variation in song activity of Reed Bunting. See Fig. 1.

Årstidsvariation i sangaktivitet hos Rørspurv. Se Fig. 1.

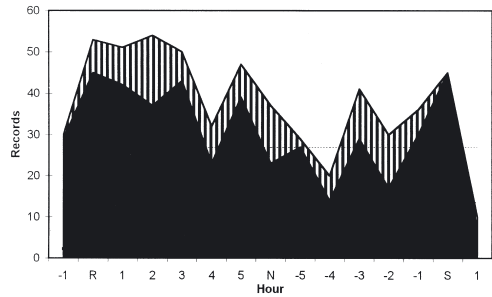


Fig. 35. Diurnal variation in song activity of Reed Bunting. See Fig. 2.

Døgnvariation i sangaktivitet hos Rørspurv. Se Fig. 2.

hour after sunset, with high activity through much of the day; at noon and during most of the afternoon activity is medium, but it increases strongly just before and around sunset and peters out shortly thereafter. The 24-hour surveys in June reveal that the species is quiet during the rest of the night.

Seasonal variation has been studied in Denmark throughout the year by Kayser (1984), who found exactly the same pattern as reported here. Diurnal variation in southern Sweden (Åström 1976, Göransson & Karlsson 1976) was similar to that found here, although the latter authors also recorded sporadic song two hours before sunrise and two hours after sunset. In northern Sweden Reed Buntings sang throughout the day and night, except for a pause between 6 p.m. and 11 p.m. (Åström l.c.).

### Corn Bunting *Miliaria calandra* (Fig. 36-37)

This species is an abundant breeding bird at site 3. The total number of song records is 386.

Apart from sporadic song in January, the song season starts in February at low song activity. Activity increases to medium level in March-April and peaks at high level in May. After low-medium song activity in June a new peak at high level occurs in July. Activity is high even in August but ceases completely before the end of the month. The low song activity in June was not immediately apparent during the field work.

The daily song period begins at sunrise at medium activity, and peaks at a high level during the following hour. The activity remains high until three hours after sunrise and thereafter decreases rapidly to a low level until mid-afternoon. There is an evening maximum at high activity two hours before sunset, falling to medium activity during the following two hours and to low activity one hour after sunset. The 24-hour surveys in June reveal that the species is quiet during the rest of the night.

Seasonal variation in England showed the same pattern as the present study, except that sporadic

song was heard also during October-January (Gyllin 1965). Exactly the same was found in Denmark (Møller 1983). The diurnal variation in May and June in Germany (Gliemann 1973), and in May in England (Gyllin 1967), closely resembles the variation found in the present study, although the evening peak appeared later, at sunset.

## Discussion

This study has given information about seasonal and diurnal variation in song activity of 20 bird species. Seasonal variation is presented for all species, and diurnal variation for 14 species; for three species 3D graphs with diurnal variation over the year are shown.

For eight of the species, no publications have been found about quantitative measurements of variation in song activity. Most of these are very common species: Lapwing, Skylark, Meadow Pipit, Sedge Warbler, Reed Warbler, Whitethroat, Greenfinch. For nine species this paper is the first to present graphs showing seasonal variation in song activity, and for five species diurnal variation is presented for the first time.

For 12 of the 20 species it has been possible to compare the results with other research. Most of these investigations were carried out less than 600 km north or south of the present study, and the reported patterns of seasonal and diurnal variation in song activity are very similar. Going farther north, the species tend to commence singing later in spring, and close to the polar circle some species that are morning and evening singers in Denmark sing throughout the light night.

Since other studies from the same geographical area, but using other methods, have given results similar to those from this study, it may be concluded that the very simple census method here used gives a fairly accurate picture of variation in song activity, and that the minimum criteria set out for the number of records required for each type of graph are adequate. Discrepancies in the seasonal variation for a few species (Wren, Robin, Blackcap) may be due to a dominance from a single season in the data set, or (Blackcap) to a rather small data set.

## Resumé

### Døgn- og årstidsvariationer i sangaktivitet

Årstids- og døgnvariationen i sangaktiviteten hos 20 fuglearter blev i årene 1993-1997 undersøgt på fire lokaliteter i Danmark: (1) Villakvarter nord for København, (2) engådal syd for Køge, (3) agerland syd for Køge og (4) strandeng på Læsø. På hver lokalitet blev der på én dag i

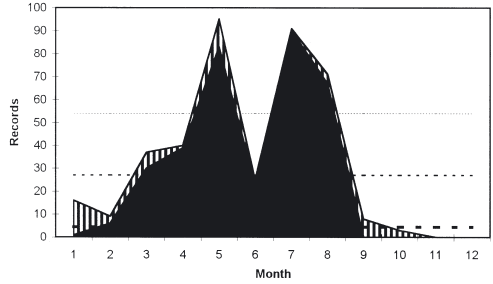


Fig. 36. Seasonal variation in song activity of Corn Bunting. See Fig. 1.

*Årstidsvariation i sangaktivitet hos Kornværling. Se Fig. 1.*

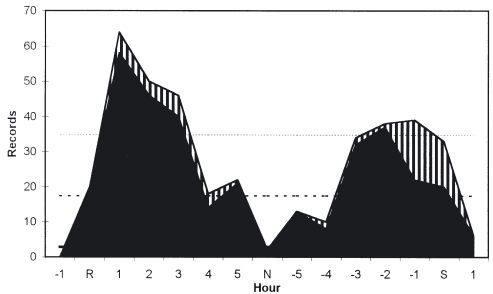


Fig. 37. Diurnal variation in song activity of Corn Bunting. See Fig. 2.

*Døgnvariation i sangaktivitet hos Kornværling. Se Fig. 2.*

hver af årets måneder talt op hver time, fra en time før solopgang til en time efter solnedgang. I juni blev der talt hele døgnet. Inden for hver time noteredes i hver af 10 éminuts perioder hvilke arter, der sang eller kunne registreres på anden måde. Samtlige tællinger blev udført af forfatteren og så vidt muligt i godt vejr.

Resultaterne præsenteres i form af grafer, ledsaget af en sammenfatning af det fundne aktivitetsmønster og af tilsvarende resultater fra tidligere undersøgelser. For 8 arter er der slet ikke fundet publikationer, som omhandler kvantitative målinger af variation i sangaktiviteten, skønt det drejer sig om almindelige arter (Vibe, Stor Regnspøve, Sanglærke, Engpiber, Sivsanger, Rørsanger, Tomsanger, Grønirisk). For 9 arter præsenteres for første gang grafer over sangaktivitetens årstidsvariation, og for 5 arter grafer med døgnvariation.

De fleste sammenlignelige undersøgelser er gennemført mindre end 600 km sydligere eller nordligere end denne. Disse undersøgelser viser for såvel årstids- som døgnvariation næsten identiske resultater, omend der er en naturlig tendens til, at jo længere nordpå undersøgelsen er foretaget, jo senere på foråret starter sangperioden.

Den anvendte metode er meget simpel, men synes med et passende stort datagrundlag som i denne undersøgelse at give et præcist billede af sangaktivitetens forløb. Denne konklusion baseres på, at undersøgelser ud-

ført inden for samme geografiske område ved hjælp af andre optællingsmetoder har givet stort set de samme resultater. Mindre afvigelser i årstidsvariationen hos nogle få arter (Gærdesmutte, Rødhals, Munk) kan skyldes en vis overvægt fra en enkelt sæson i datamaterialet eller (Munk) et temmelig spinkelt datagrundlag.

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