Display of the Great Snipe *(Gallinago media* LATHAM).

A combined investigation with observations by tape-recording and photography of the display of the Great Snipe in North Sweden. (From Bioacoustic Laboratory, Århus).

By

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(Med et dansk resumé: Tredækkerens (Gallinago media) *spil).*

During a stay in Swedish Lapland at the end of June and the beginning of July 1961 BENNY GENSBØL and the present author had the opportunity to make observations on the Great Snipe *(Gallinago media)* by tape-recording and photography. Mr. P. O. SVANBERG pointed out the display ground (700 m above sea level) in a valley in the Svaipa hills on the border between the birch and willow zones. The display ground was situated in the middle of a mountain moor area, one kilometer from a lake. The ground was very humid and alternatingly grown with *spaghnum*, scrub of dwarf birch *(Betula nana)* and willow *(Salix* sp.*)* up to 50 cm high. The investigation was favoured by the good light prevailing by midnight in Lapland, since this display ground was situated 10–20 km south of the Polar Circle (66° northern lat.). The difficulties which previous authors have had to cope with when describing the display and postures of the Great Snipe are in some degree due to the fact that the display was observed in the evening and night in more southern latitudes.

LITERATURE ON THE BREEDING BIOLOGY

The display of the Great Snipe has been described especially in the last century by many authors, notably by German, British and Swedish authors, at the time when this bird was a comparatively common breeder in South Scandinavia and North Germany.

The descriptions of the display given by various authors are very different as to exactitude and presumably much dependent on the light conditions under which the authors watched the birds. The best and most detailed descriptions were given by SVANBERG (1936), ROHWEDER (1891), ROSENBERG (1954), and COLLETT (1892). The display was described already by SÖDERBERG in 1832 (according to NILSSON (1858)), and this is presumably one of the first biological descriptions of a single bird species. It is natural that the peculiar and characteristic display of the Great Snipe has fascinated ornithological authors, because hardly any other Snipe shows such a peculiar behaviour on the ground in the breeding season. The best description of the display of the Great Snipe was no doubt given by ROHWEDER in 1891, which is also the most cited in the handbooks. This author gives a vivid description with many details of a display ground in South Slesvig which gives a good picture of a very big display ground with 40–60 birds.

The place is called "Knebberplatz" in German and was made known to him by an old hunter. (The name Knebberplatz is the South Slesvig name for a display ground, which seems to show that the bird was so common that "popular" names were given to the display grounds). (NAUMANN 1892). ROHWEDER ascertained that the birds caught – in snares – on the display ground were all males; a single author however writes that females do occur on the display ground at the beginning of the season (NILSSON 1858). COLLETT (1892) states that he collected only males on the display grounds in Norway.

Several of the authors (SEBOHM 1891, ROHWEDER 1891 etc.) give detailed descriptions of sham fights among the displaying males. The various authors disagree as to whether the Great Snipe keeps its bill open during the whole comb display; we observed that during the whole display the bill was at any rate slightly open.

The Russian ornithologists have a thorough knowledge of the breeding conditions of the Great Snipe; it appears from the part of the literature which has been accessible (GROTE 1932, KOZLOVA 1962) that the Great Snipe is considered to be polygamous, and that the females – notably late in the night – occur on the display grounds – but do not display. They are pursued by several ascending males during their stay on the display ground, and coition takes place in this area or in its nearest vicinity. ARTHUR CHRISTIANSEN, bird photographer, has informed me verbally that in the summer of 1963 he has seen several birds on a display ground in Jämtland pursuing a single bird flying early in the morning. He interpreted this observation in the same way as do the Russian authors, pointing out that this much resembled the conditions on the display ground of the Ruff *(Philomachus pugnax)*.

No "breeding monography" has been published on the Great Snipe, and since the display on the ground forms only a small part of the whole breeding cycle there are still many unknown features in the breeding biology of this bird. It can be mentioned that among other things it is not known whether it is the male or the female which incubates, or where and how coiton takes place etc. Since this interesting bird had decreased in numbers in a very high degree in North Scandinavia it would be very desirable if its biology was investigated.

By perusal of the literature I found descriptions of the following utterances in the Great Snipe, which are given below in schematic form:

1. Seldom a hoarse calling note is heard during ascent, which WITHERBY (1947) describes as "monosyllabic guttural croak". HEILMANN (1929) describes this as a hoarse snipe-like call. Similar calls have been heard by MAC NAGEL as "kep-kep" (report by BANNERMANN (1961)). FISCHER (1863) describes the call as a subdued "rhap-rhap" like that of a domestic duck, and he maintains that this call is uttered when the bird is alarmed during ascent. – In the evening a single "rhap" is heard on the feeding ground.

2. On the display ground ROHWEDER (1891) describes a "bi-bi-bi-bi"-note uttered between the displays and as an introduction to the display (what I call "interludes", but it may be the comb sound).

3. The comb sounds in the display are described by BANNERMANN (1961) as "ib-bep-ibbep", and ROHWEDER compares them to the above-mentioned movements of a nail on a comb, while SØDERBERG (1828) (according to NILSSON) describes the comb sounds as the sounds given by an air bubble, when bubbling up through water; another author describes them as resembling the sound produced by striking a broken fish bone against a table top

(GADEMAR 1858 (according to NAUMANN (1892)).

4. ROHWEDER describes the end of the display as a hoarse "orrororow", and COLLETT describes a fine, *Sylvia*-like twittering note at the end of the display. (This may be identical with my interlude).

5. Finally, a single author has described a warning note at the nest "like a Turkey cock" (GODMANN 1861).

As will appear from these statements the vocal descriptions of the notes of the Great Snipe are somewhat confusing – as is often the case with vocal descriptions of bird voices – and very often the descriptions cannot be compared from one author to another. In the following I shall only describe the sounds recorded by the taperecorder and which include the sounds described under 2, 3, and 4.

SHORT DESCRIPTION OF THE OBSERVATIONS

We had placed a photo tent about 2 m from a displaying bird, from which we watched it in three evenings and three nights (27th June, 30th June, 2nd July 1961). The bird to which special attention was paid, had as its "main display ground" a *sphagnum* mound. We feel sure that it was the same bird which all the time returned to the mound, and we feel fairly convinced that it was the same bird which displayed on that particular mound all the evenings. The bird under observation seemed to be very little disturbed by us and remained on its mound almost throughout the whole period of observation. It was watched from 10 p.m. to 2.30 a.m. in the nights in question. The display grounds were estimated to be of an extension of 20–40 sq. m. Most of the birds were separated from each other by willow and dwarf birch bushes of medium height so that it was difficult to estimate the exact number of displaying birds, but at a certain time we observed 6–10 ascending birds, and the taperecorder indicated at any rate five birds displaying simultaneously.

Under similar conditions as in Lapland 1961 B. GENSBØL and I had the opportunity to stay on a display ground in Jämtland. These observations which mainly refer to the social aspect of the display are described in another article in this number of the periodical.

Early in the evening we saw a few birds arrive silently, low above the ground in the vicinity of the display ground in their heavy, almost Wood-cock-like flight. The display started soon after, and it gradually increased in intensity. The greatest intensity was seen between 11 p.m. and 1.30 a.m.

Without cover we succeeded in approaching the displaying birds at 6–8 m, without apparently disturbing them; with a cover we were about 2 m from the undisturbed bird. When the observer had hid himself in the photo tent, the bird would arrive at its stand in 10–15 minutes.

The display which is heard on the display ground is a concert of the utterances of several individuals; they rise and fall in intensity, dependent on the number of displaying birds. The display of the single bird is a short "song", lasting 2–3 seconds, followed by some very quick changes in the position of head, bill, leg, wing, and tail. The birds "play" in a kind of chorus, so that immediately when one bird has commenced, one or several birds will join. The period between the displays of the individual birds was longer late in the

night, and in these periods between the displays they sat "sleeping" with the bill under the wing, but with open eyes. In periods between the displays of the individual bird a series of sonorous tones were heard especially at the time when the display was most intense (in the following called the interlude). By listening to the displays of the individual bird we could hear that the display was started with some musical and melodious tones. Then came the "comb sounds" which lasted c.1,3 to 2 seconds and were heard as some very short accelerating "kneks". Immediately after these a relatively longdrawn part was heard with a strongly falling tone which may be reproduced by a "vi-v". The "comb sounds" can best be compared to the tones which are produced when a nail is being run at increasing speed over a comb. This part of the display seemed to be audible at the greatest distance from the display ground – 150–200 m – which shows that the sound intensity of the display is rather low.

Technique of taperecording and photography.

The display of the Great Snipe was taperecorded by placing a microphone on the stand at a distance of about 2½ m from the photo tent. By a concealed wire the microphone was connected with a portable soundproof taperecorder (Maihak) which was operated from the tent.

In addition to the microphone, which was placed on the mound, I had another in the tent to which I could dictate in a whispering voice, simultaneously with the working of the first microphone. This device made it possible to record remarks on the movements of the bird simultaneously with recording its display. The display of the Great Snipe passes so rapidly that it is impossible to describe the changes of attitude during the display itself, and I therefore described the changes by means of a code, using numbers to indicate characteristic changes in the movements of the bird during the display. Thus the numbers below indicate the moment when the bird made the following changes of attitude.

"1". The bird begins to extend the neck, and the bill is directed obliquely upward at an angle of 45°.
"2". The bird begins to move the bill, at the same time the neck is bent, and the legs are stretched.
"3". The bird begins to spread the tail.
"4". The bird closes the tail.

By spectrographic analyses of the periods of the display during which the figures were dictated (4 periods) it proved that with an exactitude of up to 1/10 second a correlation between the dictated figures (and thereby the changes of the bird's attitude) and the spectrogram (and thereby the bird's utterances) could be ascertained.

The photographs were taken by Benny Gensbøl another evening than that in which the taperecorder was used; the photos were taken with a rapid film and flashlight. Time of exposure 1/1000 sec. The photos are seen pp. 21–26. It had been noted in which part of the display each photo was taken.

On basis of the details given by the taperecorder and the photos a description can be given of the bird's postures in relation to the display. This description is given schematically in the table of the display in fig. 9, and, in addition, an exact description of the attitude is given together with spectrographic descriptions. Unfortunately, we had no practical possibilities to take a film with synchronized sounding. This would have been the most adequate. Attempts were made in 1963, but failed owing to too little light.

Spectrographic analyses and analyses of movements during the display.

A spectrographic analysis has been made

in five of the most distinctly recorded display periods from Lapland and two from Jämtland under the guidance of Dr. POUL BONDESEN, Bioacustic Laboratory, Natural History Museum, Århus. These analyses were made on a "Kay Sonograph" according to the instructions of the factory, and it is stated on each reproduced spectrogram with which adjustments the apparatus was used. The terminology employed in the description of the spectrograms is in full accordance with the standardization of the description of voices and sound spectrograms made by BONDESEN and DAVIS (see DAVIS 1964). The spectrograms are given (figs. 10–11) in the way that on the abscissa is indicated the frequences of the tones in KHz, and on the ordinate the length of display in tenths of seconds. When reading the spectrogram it is clear at once that there are two different sound utterances, partly the well defined sounds (tones?) which appear in the spectrogram as figures with a small frequency range of between 1–2 KHz, and of a duration of up to 0.1–0.2 seconds (most of them seem to have weak overtones) and partly vertical lines in the spectrogram "passing through" the whole audible spectrum. These must be described as white noise ("Bill click") and are identical with the previously described "comb sounds" heard at an especially great distance. The more musical sounding figures which represent the greater part of the spectrogram are probably caused by the sound organs of the birds. Since most of the spectrograms are disturbed by other birds' display, I have drawn a sketch of one of the spectrograms both for descriptive and for practical reasons (see fig. 9. (This sketch is a copy of the "most distinct spectrogram" – no. VI)). On this schematic figure of the spectrogram is further inserted the sections in the spectrogram described below. In the description of the spectrogram the whole "display" is divided into two sections, and these consist of three or two motives. Fig. 9 clearly shows the limit between these two sections and motives. This division of the spectrogram is adequate, partly for comparing the sound with the attitude of the bird, partly for systematizing the description.

Table 1 shows the different sections and the duration of motives in seconds – measured on the individual spectrograms.

Three "typical" spectrograms – two of the bird in Lapland, and one of the bird in Jämtland – are shown in figs. 10, 11, and 12. The latter shows the interlude and the "motor sound" (see later).

DESCRIPTION OF ATTITUDES AND SPECTROGRAMS

SECTION I

Section 1 consists of a succession of figures coming in an even, curved movement. There are about 17 figures in the section, and between every two figures there is a comb sound. The duration of the section is about two-thirds of the whole display period – about 2.0 seconds on average.

The most characteristic feature in this part of the display is that the bill is moved in a rhythm synchronally with the comb sounds, without being entirely closed. Our observations and interpretation of the photos seem to indicate that by the movement made the tips of the upper- and lower-bill approach eachother, and at that time in the same rhythm as the comb sound (see fig. 13). This must be a very quick movement which is only reproduced in two of the numerous photos of this part

Spectrogram no.	Place and date	Section I			Section II		Total duration
		Motive 1	Motive 2	Motive 3	Motive 1	Motive 2	
I	Lapland 29.6.1961	0,64	0,68	0,72	0,25	0,65	2,96
II	– –	0,62	0,65	0,68	0,25	0,70	2,86
III*)	– –			0,70	0,25	0,65	
IV*)	– –		0,69	0,72	0,26	0,72	
V	– –	0,76	0,68	0,72	0,25	0,68	3,6
X	– –	0,70	0,65	0,71	0,25	0,70	3,04
Average for bird, Lapland 29.6.1961		0,68	0,67	0,71	0,25	0,68	3,11
I	Jämtland 26.6.1963	0,50	0,65	0,62	0,25	0,70	2,76
II	– –	0,52	0,65	0,62	0,24	0,72	2,92
III	– –	0,51	0,65	0,62	0,25	0,70	2,76
Average for bird, Jämtland 26.6.1963		0,51	0,65	0,62	0,25	0,70	2,81

*) Only partly analysed.

Table 1. Duration of the analysed display periods as well as the length of the single motives and sections (see fig. 9). The time is indicated in seconds. A mean has been calculated for the length of the display period for the Jämtland and Lapland birds, showing that the duration of the display of these two birds is different.

Tabel 1. De analyserede spilleperioders varighed, samt de enkelte motivers og sektioners længde (se fig. 9). Tidsangivelse er i sekunder. Der er udregnet et gennemsnit af varigheden for Jämtlands og Laplandsfuglens spilleperiode, som viser, at der er en forskel mellem disse to fugles spillelængde.

of the display, and in these pictures the movement appears as a shadow (fig. 3), and only one picture clearly shows the closing position.

1st section motive 1. This first motive goes from the beginning of the display, when the bird makes the first change of postures to the limit marked in fig. 9. Since it is difficult to indicate exactly this first limit for the motive, the length is measured with a greater dispersal than the other motives of the display, as it has a duration of from 0.50 to 0.76 second. The figures which are heard as melodious tones in this motive have a frequency of 2,5 to 4 KHz the single figures are similar to certain figures in the interlude and are rectangular to rhomboid with a vertical longitudinal axis. The frequency of the individual figures are gradually increasing in the motive.

In this period the bird makes a very quick change of attitude from the resting position (attitudes 1 and 2 in fig. 9) to an attitude in which it stretches the bill 45° upward, extends the neck, thereby straightening itself, at the same time holding the tarsal joint bent at 70° (attitude 3 in fig. 9).

1st section motive 2. This motive consists of segments of five "comb sounds" and five figures between these. The motive has a duration varying between 0.65 and 0.69 second. The figures in this motive are clearly distinguished from the figures in the first motive, i.a. by consisting of two segments, one going upward and one going downward, so that the individual figure is "down-and-up-glissades".–Both the comb segments and the figures come at a slightly increasing speed, so that the length of the figures decreases in the motive, and at the same time the average frequency of the single figures is gradually rising. In some of the spectrograms faint overtones of these figures are seen.

At the beginning of this motive the bird makes a rapid change of attitude so that the posture is changed from attitude 3 to attitude 4 (fig. 9). Attitude 3 lasts only from one-fifth to one-third second. The bill is moved in this motive and the next in rhythm with the comb sounds from an attitude in which it is open at about 5° to a position in which the upper and lower bill is bent so that only the tips touch eachother. (Fig. 13). The body is raised in such a manner that the bird stands on the outermost joints of the toes and maximally extends in the tarsal-knee- and hip-joints. The neck is curved in an S, and the tail, which is closed, is bent slightly upward.

Section 1 motive 3. This motive has a duration of between 0.62 and 0.72 second. In its main features this motive is similar to the preceding one, except that the comb sounds are heard at an increasing speed, and the figures between these therefore become shorter with falling frequency. Between the last comb sounds there are no figures. If we listen to this motive and the preceding one we hear some clanging tones, heard at an increasing speed, and the figures and comb sounds cannot be distinguished. It is this part of the display which can be heard at the greatest distance. The number of figures varies from 5 to 7, and the single figure is almost rhomboid shaped with a decreasing frequency (opposite motive 1).

The attitude of the bird during this motive is the same as in the preceding motive (posture 4), but the bird is shaking all over the body and thereby seems to be in greater ecstacy.

SECTION II,

represents the final phase of the acoustic display. It has been defined as the part of the display which lasts from the end of the continuous comb sounds till the sound ceases (the display itself does not cease before the bird has closed its tail – this occurs 1.5–3 seconds after it has become silent (see table 1)). The motive lasts about one second and is heard as a long-drawn vii-vi. The section is divided into two motives, and the limit between these two has been put where the great complex tone with the overtones begins.

Section II motive 1. The first of these motives consists of some complicated figures going steeply up and down, and one of these figures has as its highest point a frequency of 7–8 KHz. In between these are single comb sounds. The motive has from the spectrogram a very constant length of 0.25 second.

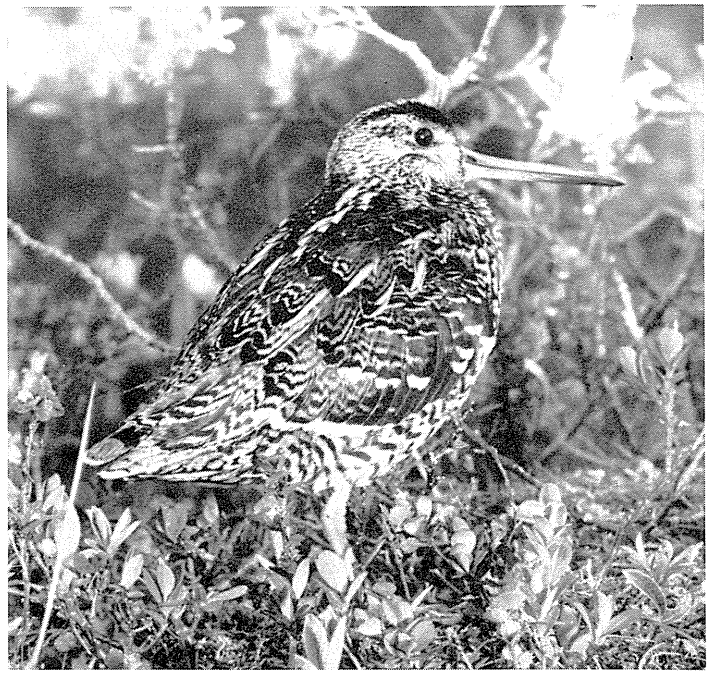
At the beginning of this motive the bird commences some rapid and complicated changes of posture, which are seen as attitude 5 in fig. 9. These changes are not completely finished at the transition to the next motive.

The change of attitudes begins with a lowering of the tail, which is then spread maximally and turned sideways so that the outermost white tail feathers are distinctly seen. (In the dusk this is the most conspicuous part of the bird). Then the bird flaps the wings in one movement. During this flapping the wing is kept bent in the elbow joint and the wrist is somewhat curved. The bill is directed forward and opened about 20° for a short moment. The changes in positions of bill, wings, neck and legs are so quick in this motive that it has not been possible, with the technique used, to state the exact time of these – which is expressed in fig. 9 by placing a point of interrogation at the time of the changes of the attitude.

Section II motive 2. Motive 2 are the last sounds in the display, but the "display posture" is not terminated until later, – when the tail is closed, 1.5–3 seconds after the sounds have ceased. The whole motive is seen on the spectrogram as a great

All photos Swedish Lapland June 27th 1961.

Fig. 1. Great Snipe on display ground. Corresponding with 1st attitude in fig. 9. (Photo: BENNY GENSBØL).
Fig. 1. Tredækker på spilleplads, 1. stilling på fig. 9.



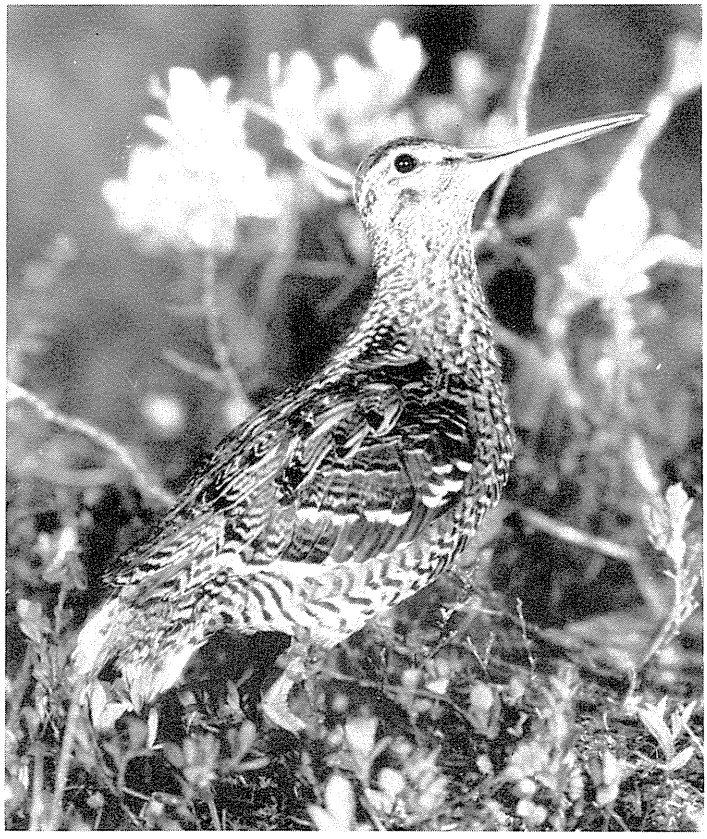


Fig. 2. Great Snipe in the beginning of the display, corresponding with 2nd attitude in fig. 9. (Photo: BENNY GENSBØL).
Fig. 2. Tredækker i begyndelsen af spillet, svarende til 2. stilling på fig. 9.

Fig. 3. Great Snipe in display. Corresponding with the 3rd attitude in fig. 9. Note the shade of the moving bill, also shown in fig. 13. (Photo: BENNY GENSBØL).
Fig. 3. Tredækker i spil, svarende til 3. stilling på fig. 9. Bemærk skyggen af næbbevægelsen, som også er indtegnet på fig. 13.

Fig. 4. Great Snipe in display, corresponding with the 4th attitude in fig. 9. (Photo: BENNY GENSBØL).
Fig. 4. Tredækker i spil, svarende til 4. stilling på fig. 9.

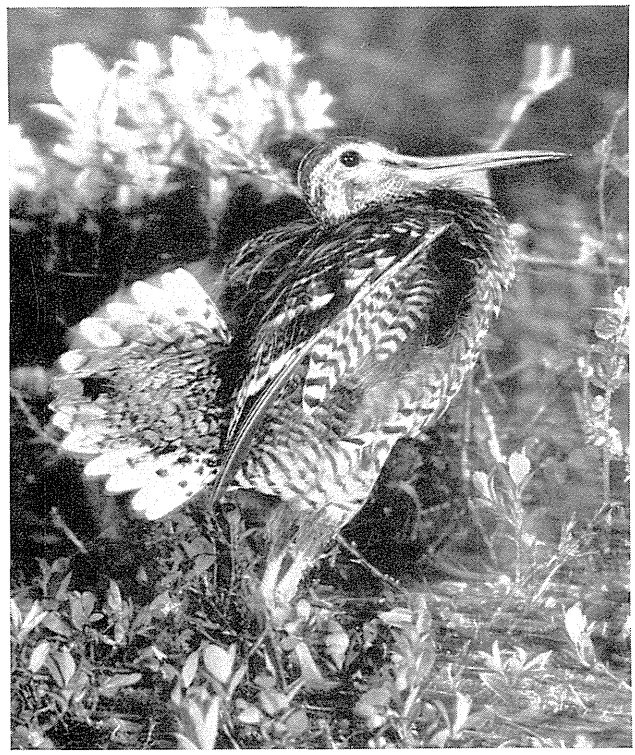


Fig. 5. Great Snipe in display, partly corresponding with 4th attitude in fig. 9. (Photo: BENNY GENSBØL).
Fig. 5. Tredækker i spil, delvis svarende til 4. stilling på fig. 9.

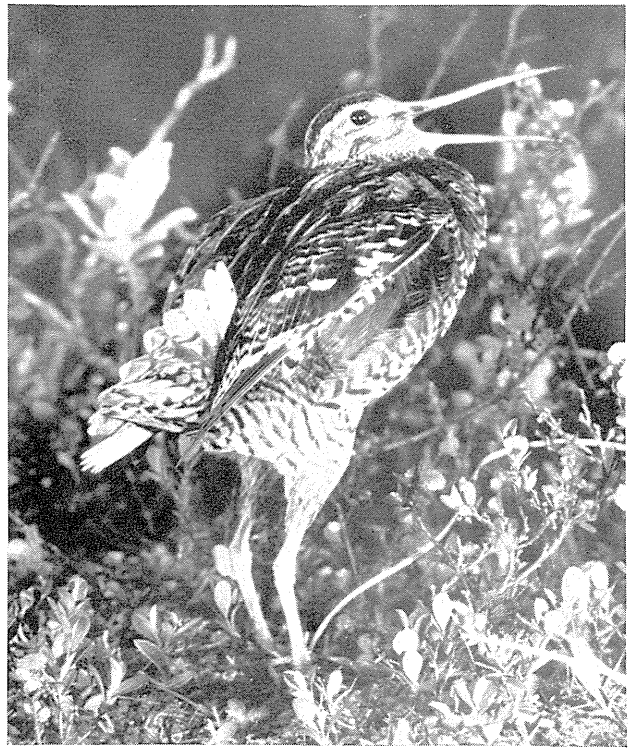
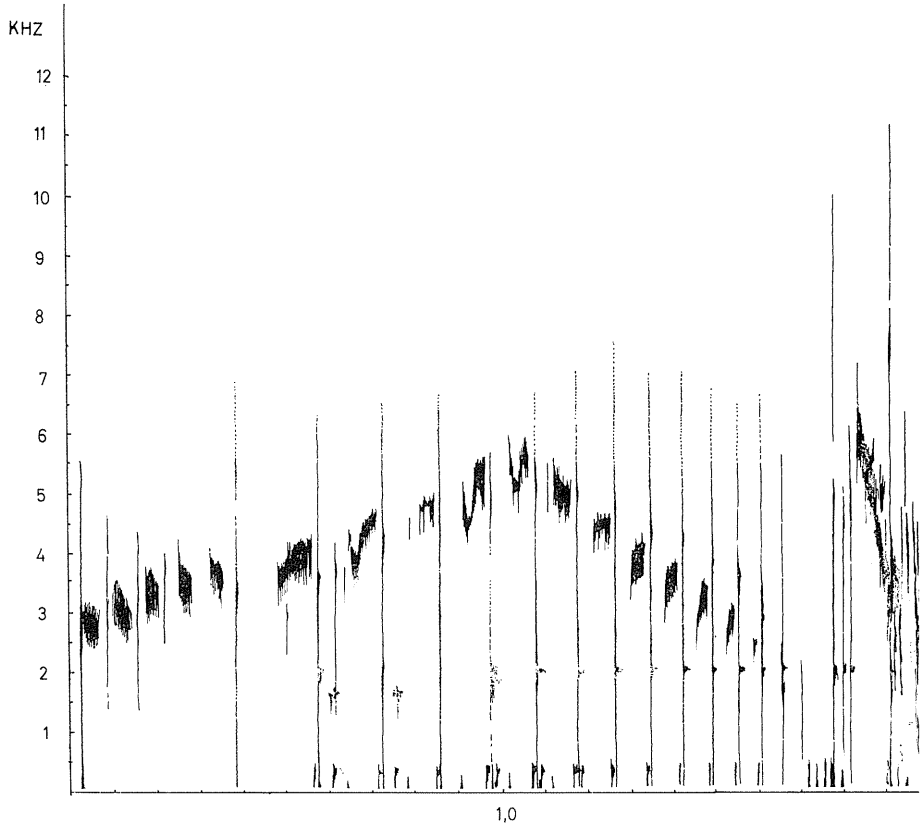
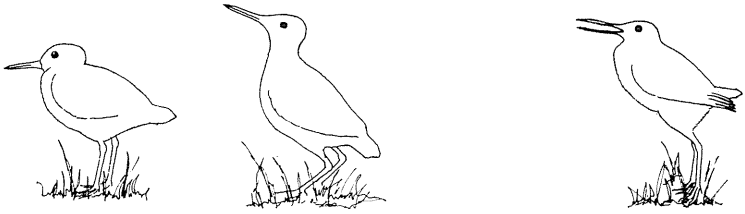
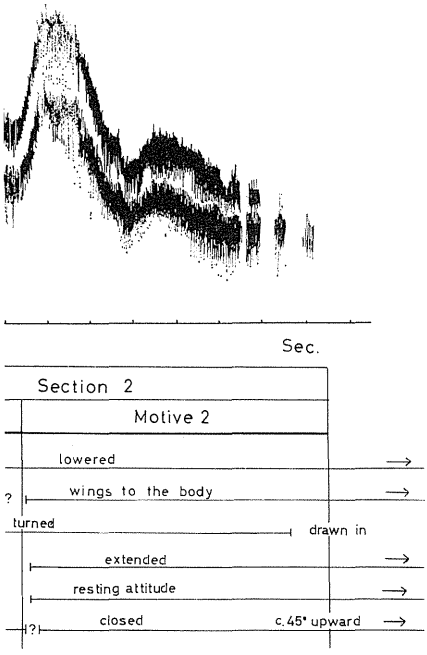


Fig. 6. Great Snipe in display, corresponding with 4th attitude in fig. 9. (Photo: BENNY GENSBØL).
Fig. 6. Tredækker i spil, svarende til 4. stilling i fig. 9.



Sections of spectrogram	Section 1			
Motives of spectrogram	Motive 1	Motive 2	Motive 3	Mo
Attitude of body		shaking raised		
Attitude of wings		wings to the body		one wing f
Attitude of tail		bent 30° upward		spread, lowe
Attitude of neck	extended	curved in an S		
Attitude of legs	tarsal joint bent 70°	raises on toes, extends in tarsal-knee- and hip joints		
Attitude of bill	45° upward	bill horizontal, open; moved a few degrees	synchronous with comb sounds ?	op





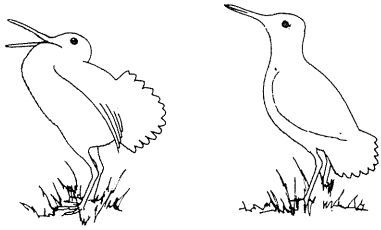


Fig 9. In this figure the temporal correlation between the movements and sounds of the birds within a display period has been entered, the spectrogram showing the sound utterances. The different attitudes adopted by the birds in a display period have been schematically drawn from the photographs (figs. 1–8). The many movement changes which have been demonstrated are described schematically, and here the movement changes which could not be exactly determined have been indicated with a point of interrogation.

Fig. 9. På dette skema er den tidsmæssige korrelation mellem fuglens bevægelser og lydytringer i en spilleperiode indført, idet spektogrammet viser lydytringerne. De forskellige stillinger fuglen indtager i en spilleperiode er skematisk tegnet efter fotografierne (Fig. 1–8). De mange bevægelsesforandringer der er blevet påvist, er skematisk beskrevet, og her har man med ? angivet de bevægelsesforandringer der ikke har kunnet fastsættes nøjagtigt.

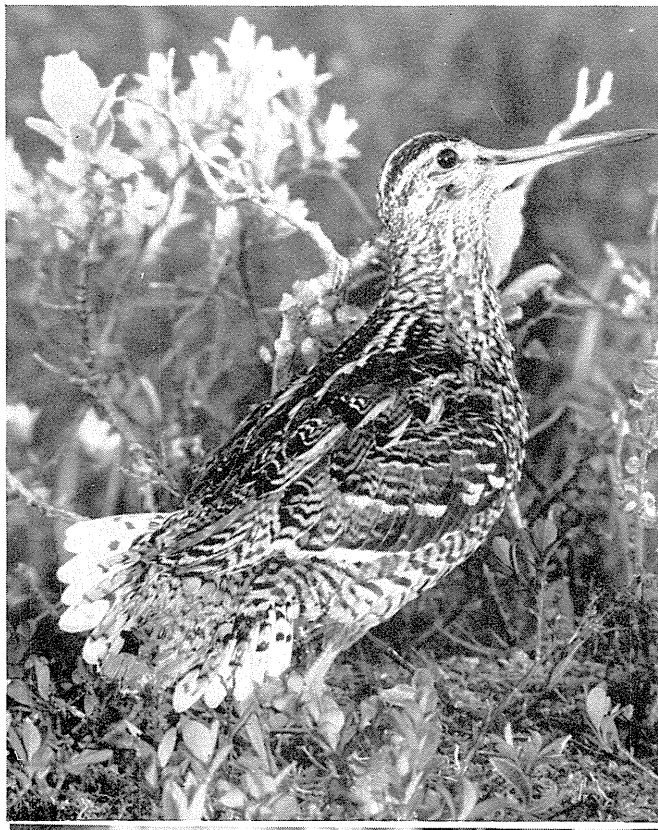


Fig. 7. Great Snipe in display, corresponding with 5th attitude in fig. 9. (Photo: BENNY GENSBØL).
Fig. 7. Tredækker i spil, svarende til 5. stilling på fig. 9.

Fig. 10 (Page 27). Sound spectrogram of a single period of the display of a Great Snipe from Lapland 29/6.61. The "shadows" in the spectrogram which are marked with the figures 1, 2, 3, and 4 are the dictated codes used for analyzing the movements of the bird during the display. The most conspicuous figures are the sounds from the nearest bird (compare with fig. 9), more faintly indicated the sounds from two other birds are also seen. On the abscissa the time is indicated in seconds, and on the ordinate the sound vibrations are indicated in KHz. The analysis was made on a Kay Sonograph in the positions: H.S., Wide, and with "mark level" 8.
Fig. 10. Lydspektogram af en enkelt spilleperiode fra Tredækkerensspil fra Lapland 29/6 61. De »skygger« i spektogrammet der er mærket med tallene 1, 2, 3 og 4 er de dikterede talkoder, som er anvendt til analyse af fuglens bevægelser under spillet. De mest fremtrædende figurer er lydene fra den nærmeste fugl (sammenlign med fig. 9), svagere aftegnet ses der også lyde af to andre fugle. På abcissen er tiden angivet i sekunder, og på ordinaten er lydsvingningerne angivet i KHz. Analysen er foretaget på Kay Sonograf i stillingerne: H.S., Wide og med »mark level« 8.

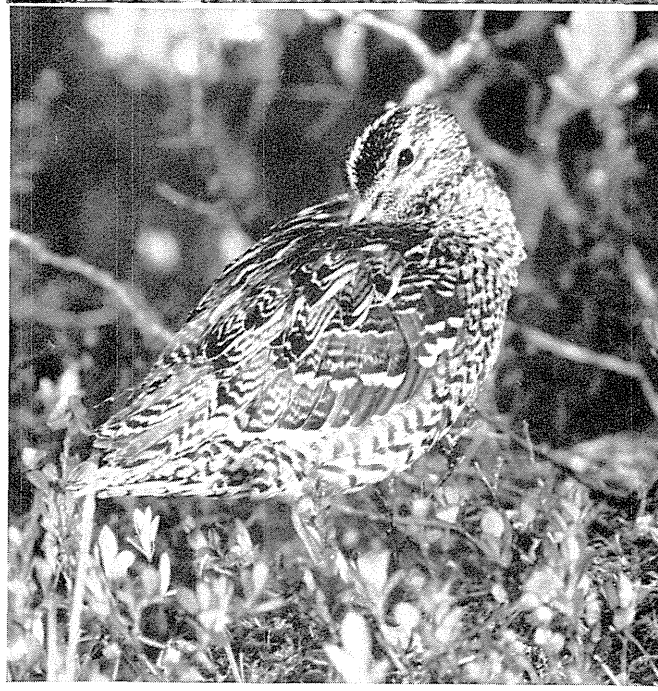


Fig. 8. Great Snipe in resting attitude with eye open. (Photo: BENNY GENSBØL).
Fig. 8. Tredækker i hvilestilling med åbent øje.

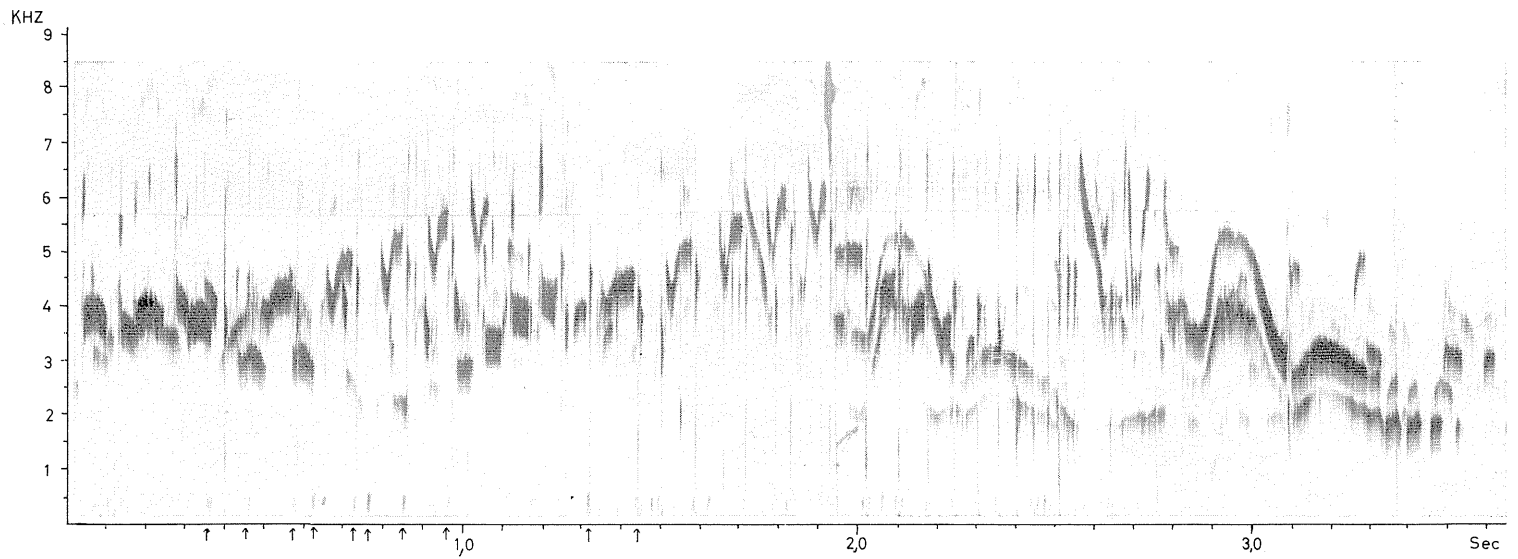


Fig. 11. Text page 28.

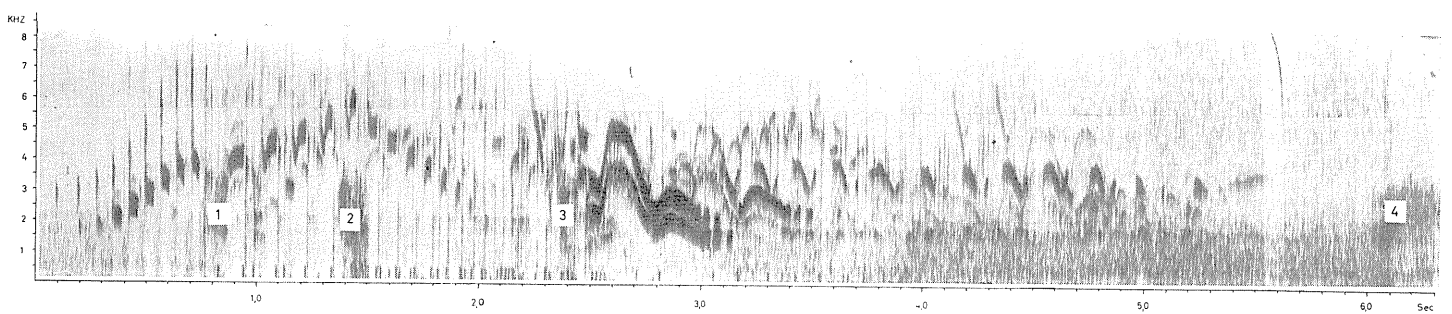


Fig. 10. Text page 26.

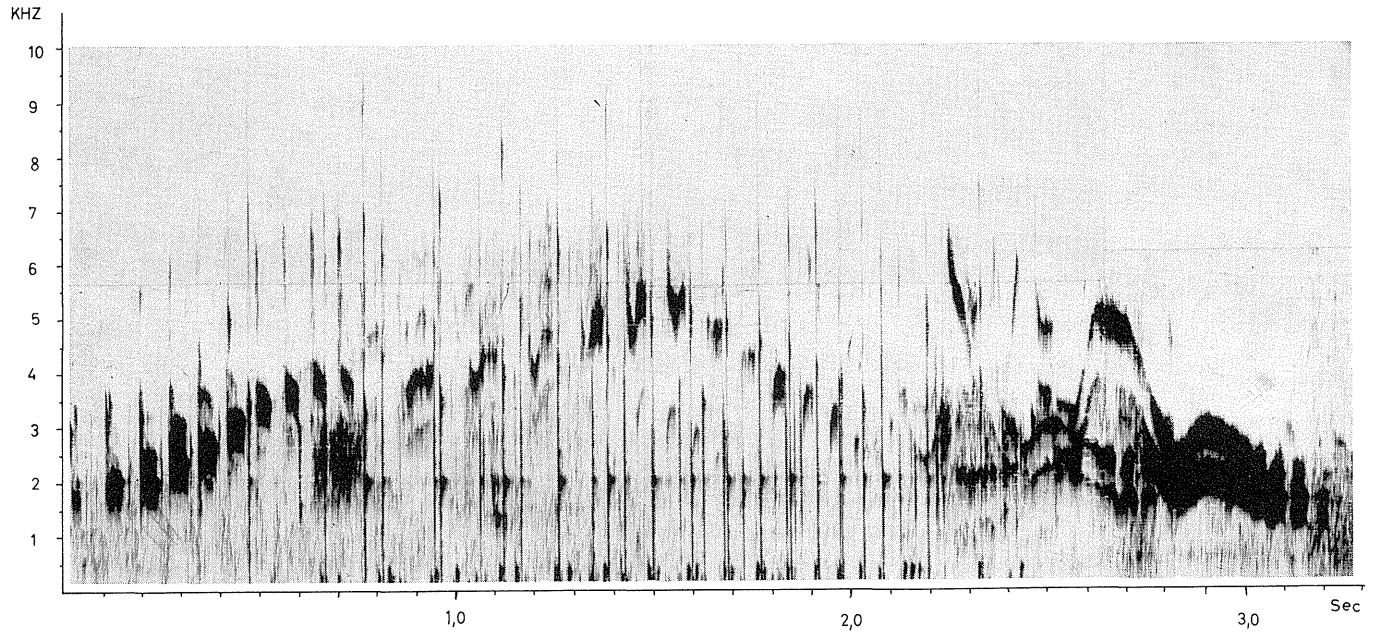


Fig. 12. Sound spectrogram of a display period of a single bird from Lapland 29/6.61. This spectrogram is especially distinct, and what is indicated by the vertical lines are the comb sounds. At the base of these some comma-shaped figures are seen; these correspond to the motor sounds. Regarding the technical data see fig. 10.

Fig. 12. Lydspektogram af en enkelt fugls spilleperiode fra Lapland 29/6 61. Dette spektogram er særligt tydeligt, og de lodrette streger angiver kamlydene. Ved grunden af disse ses nogle kommaformede figurer, disse svarer til motorlydene. Vedrørende de tekniske data, se fig. 10.

Fig. 11 (Page 27). Sound spectrogram of a display period from Jämtland 26. juni 1963. The display of two birds have been drawn one a little more distinctly than the other (compare with fig. 9). In the first 1.2 seconds of the spectrogram the interlude of the one bird is seen (partly coinciding with the beginning of the display of the other). The figures indicated with arrows are the figures which in the text are described as the motor sounds. – Technical data see fig. 10.

Fig. 11 (Side 27). Lydspektogram af en spilleperiode fra Jämtland 26. juni 1963. To fugles spil er aftegnet, den ene lidt kraftigere end den anden (smlg. med fig. 9). På de første 1,2 sekunder af spektogrammet ses mellemspillet af den ene fugl (delvis sammenfaldende med begyndelsen af spillet af den anden). De med pile angivne figurer er de figurer der i teksten er beskrevet som motorlydene. Tekniske data, se fig. 10.

curved figure followed by from 2–4 small figures which come as a "tail" in the great figure. The great figure has a very strong drawing with an overtone which appears wavy in the spectrogram – and by this characteristic shape this figure is easily recognizable, even when it is faintly drawn. These figures have been used to count the number of birds displaying at the same time in the individual spectrograms. The motive lasts 0.75 second on average.

From attitude 5 described above the posture of the birds in this motive is gradually changed to the closing posture in the display (attitude 6) which it adopts when the utterances have ceased completely. The bill is closed and stretched upward at an angle of 45°, the wings are kept close to the body, the tail is slowly drawn in, and the attitude then resembles the posture which the bird adopts at the beginning of the display (posture 3). At the beginning of the motive the body is lowered when the bird again treads on the entire foot sole and inflects "normally" in hip- ,knee- and tarsal joint – thereby the neck is straigthened as the head is still kept in the same horizontal plane. Due to technical difficulties the exact judgment of the time when the change of attitude sets also in in this motive is encumbered with greater uncertainty than the previous motives.

INTERPLAY OF BIRDS

The display of many single birds form a chorus of birds – as described by other authors – whose "song" flows over the display ground, since each wave begins in a certain place on the ground and then spreads over it. (SWANBERG, ROHWEDER etc.). When the display is at its maximum these waves come at intervals of about 20 seconds. By registration of one of the spectrograms from Lapland I found at any rate five individuals participating in such a wave, and the difference between these five birds in this wave came at intervals of 0,2–0,15–1,4–0.2 seconds.

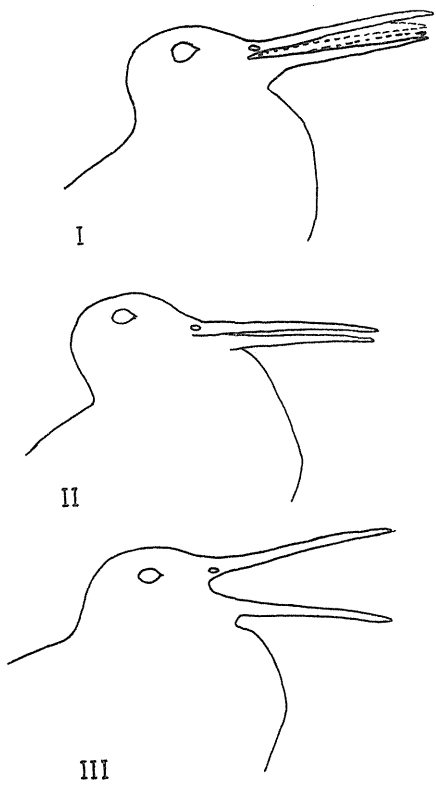


Fig. 13. Sketches of the attitudes of head and bill in a display period, drawn from photographs. On sketches I and II the attitude is seen at the beginning of the display, when the bill is being moved synchronously with the comb sounds. On the uppermost sketch I the movement of the bill is shown by a broken line, as only the outermost half of the bill is moved, and especially the upper bill. (This sketch was made from the photograph in fig. 3 — where the movement is seen as a shadow).

The lowermost sketch (III) in the figure shows the attitude of the bill during the last part of the display — when the strong »viiv-sound« is produced.

Fig. 13 Skitser af hovedets og næbbets stillinger i en spilleperiode, tegnet efter fotografier. På skitse I og II ses stillingen i begyndelsen af spillet, hvor næbbet bevæges synkront med kamlydene. På den øverste skitse I ses den bevægelse som næbbet foretager optrukket med en stiplet linje, idet kun den yderste halvdel af næbbet bevæges og da særligt overnæbbet. (Denne skitse er lavet efter fotografiet på fig. 3 — hvor bevægelsen ses som en skygge).

Den nederste skitse III på figuren viser fuglens næbstilling under den sidste del af spillet — når den kraftige »viiv« lyd frembringes.

The observations on the display ground and the record gave no impression of whether there was a definite "pattern" in the beginning of these waves so that they alternated regularly at the commencement of the display between the different parts of the display ground (as stated by ROHWEDER (1891) in a very large display ground).

THE SOUNDS BETWEEN THE DISPLAYS (THE INTERLUDES)

At the time when the display is at its maximum (about midnight) there are no silent periods, not even between the waves of display, but a constant, faint, songlike twittering is heard from the entire ground. This I have called the interlude, and a spectrographic analysis of this interlude appears from fig. 11. This interlude consists of simple figures which in frequencies lies between 2 and 4,5 KHz, and where the shape of the figures is very similar to that of the figures in section 1 motive 1, but in the interlude the figures come at a constant rate with 6–9 figures per second. In addition to these figures there are in some interludes figures which are similar to the figure in section I motive 2. Several of the spectrograms show how these figures continue successively in section I–motive 1–figures. During the interlude the bird adopts the resting attitude which is drawn as attitude 2.

When this interlude is at its maximum the bill is opened and closed as in section I in rhythm with the figure. This probably occurs when the comb sound segments are produced, as these are seen in the spectrogram.

THE ORIGIN OF THE COMB SOUNDS

During the recording on the display ground in Jämtland a sound was heard in several evenings which we had not heard in Lapland. It was a very faint, deep tone which came regularly, and it resembled the sound from a motorboat at a great distance.

This sound was only heard from the nearest birds and must be very faint, since it could hardly be heard although the distance to the bird was only about two metres. The bird was in resting posture, and it was clearly seen that it moved some of the central and lowermost chest feathers synchronously with the motor sound.

I succeeded in recording this sound by the taperecorder, and the analysis with the spectrograph shows a very interesting thing, since the sound itself on the spectrogram is a streak-like segment, the frequency of which goes from the lowest measurable value to about 0,4–0,5 KHz.

By studying this series of "motor sounds" in two spectrograms (figs. 10 and 11) I found that the sound in these two periods gradually passed into billclick segments (comb sounds) in section I of the display.

The matter was however complicated by the fact that in most of the spectrograms "motor sounds" were seen round the base of the comb sounds so that, as a rule, there were two "motor sounds", here one on either side of this (fig. 11).

VARIATIONS IN THE SPECTROGRAMS

In the description of the spectrograms I have only described the most characteristic features, excluding many details. The spectrogram of the Great Snipe is very complicated, especially compared to that of many songbirds. I have considered many of the excluded details, but did not think it adequate to discuss them in the present relation. There are however a few which I would point out. A number of variations in the spectrogram makes it probable that the individual bird has its special "spectrographic picture" which is hardly audible to the human ear. Altogether nine display periods have been analysed, and five of these are from a single bird in Lapland and three from one

bird in Jämtland; a comparison of the spectrograms of these two birds shows that there are certain differences which are probably due to differences in the utterances of different individuals.

The spectrograms of the two birds are distinguished from eachother in the following way.

1) *The length of the display period.* The period of the Lapland bird was measured at 3.11 seconds on average, while the display of the Jämtland bird lasted 2.81 seconds (table 1).

2) *Difference in number of figures in the different sections.* In the third motive of section I six figures are seen in the Lapland bird, while there are five figures in the Jämtland bird.

3) *In the second motive of Section II* "the tail" in the strongly undulating figure in the Jämtland bird consists of four figures, while in the Lapland bird it consists of two or three figures (see figs. 10 and 11).

Such difference in inaudible details on the display ground from one individual to another has been demonstrated in several bird species in recent years (BORROR cited from LAYNON (1960)) and this author characterized it in the following way: "The graphs are like a signature. They are characteristic for individual bird".

It would not have been possible to carry out this work without the assistance by several persons to whom I here extend my most cordial thanks, especially to my fellow travellers in Sweden, Mr. BENNY GENSBØL, JES FERDINAND and ANNI FERDINAND. I would like to extend a special thanks to BENNY GENSBØL for permission to use his excellent photos from the display grounds. I owe a special debt of gratitude to the leader of the Acoustic Laboratory in Århus, Dr. P. BONDESEN, for his never failing interest and help with the analyses and for valuable advice. I cordially thank Mr. P. O. SVANBERG, Skara, Sweden, Dr. Sv. NORUP, and the bird photographer ARTHUR CHRISTIANSEN for supplying data on the breeding biology of the Great Snipe. I also thank Mr. BENT PORS NIELSEN for help with the translation of Russian literature, Prof. H. JOHANSEN for bringing the Russian literature to my notice, and Mrs. AGNETE VOLSØE for translating the manuscript.

SUMMARY

By observations, records by taperecorder and photos on display grounds in Sweden of the Great Snipe *(Gallinago media)*, in Lapland and Jämtland the author gives a detailed description of the complicated and stereotypic utterances and changes in postures during the display, with spectrograms of voices as a basis (see fig. 9).

The tape records are analysed by a "Kays sonograph" and with simultaneous remarks by the author during recording the author shows that there is a "fixed" correlation between the utterances of the bird and its postures during the display. The spectrograms of these utterances are very complicated, and the most important details in these are described. The author considers that there is a difference between the voices of the single individuals, which can only be registered on the spectrograms.

Besides these features relating to the sounds uttered by the individual bird it is demonstrated by spectrograms how great a difference in time there is between the displays of the different individuals.

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DANSK RESUMÉ

Tredækkerens (*Gallinago media*) spil.

Under et ophold i Lapland og Jämtland i slutningen af juni og i begyndelsen af juli 1961 og 1963 havde BENNY GENSBØL og forfatteren lejlighed til at gøre iagttagelser og foretage båndoptagelser og fotograferinger på spilleplads for Tredækkeren (Capella media).

Tredækkerens opførsel på spillepladsen er beskrevet af mange forfattere, men de vokale beskrivelser af Tredækkerens stemmeytringer er noget forvirrende – som vokale beskrivelser af fuglestemmer ofte er. Der er ikke skrevet nogen ynglemonografi over Tredækkeren.

Spillepladsen havde skønsmæssigt en udstrækning af 20–40 m². De fleste af fuglene adskiltes fra hverandre ved middelhøje vidje- og dværgbirkebuske, således at det var vanskeligt at bedømme det nøjagtige antal af spillende fugle, men på et vist tidspunkt iagttog vi 6–10 opflyvende fugle.

Udækket lykkedes det at komme på 6–8 meters afstand af de spillende fugle, uden at de syntes at blive forstyrret; med skjul var vi ca. 2 meter fra den uforstyrrede fugl.

Det spil, som høres på spillepladsen er et samspil af flere individers stemmeytringer; det stiger og daler i intensitet, afhængig af, hvor mange fugle, der spiller. Spillet hos den enkelte fugl er en kort »sang« på 2–3 sekunders varighed fulgt af nogle meget hurtige ændringer af hoved-, næb-, ben-, vinge- og halestilling.

Teknik ved båndoptagelser og fotografering.

Tredækkerens spil blev optaget på bånd ved at en mikrofon var anbragt på fuglenes standplads ca. 2½ m fra fototeltet. Foruden den mikrofon, der var anbragt på tuen, havde jeg en mikrofon i teltet. Denne anordning muliggjorde således, at jeg samtidig med at jeg optog fuglens spil, kunne indspille notater om dens bevægelser. Jeg beskrev stillingsændringerne ved hjælp af en talkode (se fig. 10), idet jeg brugte tal til at angive karakteristiske forandringer i bevægelserne under spillet.

Ved de spektrografiske analyser af de passager af spillet, hvor tallene var indtalt viste det sig, at der med 1/10 sek. nøjagtighed kunne konstatere en forbindelse mellem de dikterede tal (og dermed fuglens stillingsændringer) og spektrogrammerne (og dermed fuglens stemmeytringer).

Fotografierne blev taget af BENNY GENSBØL. Exponeringstiden var 1/1000 sek. (ses på fig. 1–8).

På grundlag af de oplysninger, som båndoptagelser og fotografier har givet, kan der gives en beskrivelse af fuglens stillinger i forhold til spillet. Denne beskrivelse er gengivet skematisk på skemaet over spillet på fig. 9. Spektrogrammerne er afbildet (fig. 10–12), således at der på abcissen er angivet tonernes højde i KHz og på ordinaten spilletiden i tiendedel sek. Ved en aflæsning af spektrogrammet bliver man straks opmærksom på, at der er to forskellige lydytringer, dels de musikalske lyde, der på spektrogrammet ses som figurer med et lille frekvensområde på mellem 1–2 KHz og af en varighed på op til 0,1–0,2 sek. (nogle af dem med overtoner), og dels lodrette streger, der »går gennem« hele det hørbare spektrum. Disse sidste må beskrives som »White Noise« (»Bill click«) og disse segmenter er identiske med de tidligere beskrevne »kamlyde«, der høres på særlig lang afstand. På denne skematiske gengivelse (fig. 9) af spektrogrammet er der desuden foretaget indtegningen af de beskrevne sektioner og motiver i spektrogrammet. I beskrivelsen af spektrogrammet inddeles hele »spillet« i to sektioner, og disse består af henholdsvis 3 og 2 motiver. Ved at aflæse fig. 9 ser man umiddelbart grænsen mellem disse sektioner og motiver.

På tabel I ses en tabel over de forskellige sektioner og motivers varighed – målt på de enkelte spektrogrammer.

Samspillet af fugle.

De mange enkelte fugles spil danner, som andre forfattere har beskrevet, et kor af fugle, hvis »sang« bølger hen over spillepladsen, idet hver enkelt bølge begynder et bestemt sted på pladsen og så forplanter sig hen over denne (SVANBERG, ROHWEDER m. fl.) .Når spillet er på sit højeste, kommer disse bølger med ca. 20 sek.'s mellemrum. Ved måling på et af spektrogrammerne fra Lapland fandtes der i hvert fald impliceret 5 individer i en sådan bølge, og forskellen mellem disse 5 fugle i denne bølge kom med 0,2–0,15–1,4–0,2 sekunders mellemrum.

Beskrivelse af stillinger og spektrogrammer.

Sektion I.

Det mest karakteristiske ved denne del af spillet er, at næbbet bevæger sig i rytme synkron med kamlydene, uden at det dog lukkes helt. Ved iagttagelser og tydning af fotografierne mener vi at kunne sige, at den bevægelse, der sker, er en sammenbøjning af over- og undernæbbets spidser mod hinanden på det tidspunkt i samme rytme som kamlyden (»billclik«) (Se fig. 11). Dette må være en meget hurtig bevægelse, som kun er aftegnet på to af de mange optagne fotografier af denne del af spillet, og på disse billeder ses bevægelsen som en skygge (fig. 3), og kun på eet billede ses lukkestillingen skarpt.

1. sektion motiv 1.

Dette første motiv går fra begyndelsen af spillet, hvor fuglen foretager de første stillingsændringer til grænsen, der er afsat på fig. 9. De enkelte figurer minder om visse figurer i mellemspillet og er rektangulærer til rombe-formede med en lodret længdeakse. De enkelte figurers frekvens er jævnt stigende i motivet.

I denne periode foretager fuglen en meget hurtig stillingsændring fra hvilestillingen (stilling 1 og 2 på fig. 9) til en stilling, hvor den strækker næbbet 45° opad, strækker halsen og derved retter sig op, samtidig med at den holder fodleddet bøjet 70° (stilling 3 på fig. 9).

1. sektion motiv 2.

Dette motiv består af segmenter af 5 »kamlyde« og 5 figurer mellem disse. Motivet har en varighed varierende fra 0,65 til 0,69 sekund.

Ved dette motivs begyndelse foretager fuglen en hurtig stillingsændring, således at stillingen forandres fra stilling 3 til stilling 4 (fig. 9). Stilling 3 varer kun fra 1/5–1/3 sekund. Næbbet bevæger sig i dette motiv og i næste motiv i takt med kamlydene, fra en stilling, hvor det er ca. 5° åbent til en stilling, hvor over- og undernæb er krummet, således at kun spidsen af næbbene berører hinanden. (Se fig. 13). Kroppen hæves ved at fuglen både stiller sig op på tæernes yderste led og maksimalt ekstenderer i fod, knæ og hofteled. Halsen krummes S-formet, og halen, der er samlet, bøjes let opad.

Sektion 1 motiv 3.

Dette motiv har en længde mellem 0,62 og 0,72 sekund. I hovedtrækkene minder dette motiv om det foregående, bortset fra, at kamlydene kommer i et stigende tempo og figurerne mellem disse derfor bliver kortere og deres frekvens er faldende.

Fuglens stilling under dette motiv er som i det foregående motiv (stilling 4) fig. 9, men fuglen ryster over hele kroppen og virker derved mere ekstatisk.

Sektion II.

– er det lydmæssige spils slutningsfase. Den er defineret som den del af spillet, som varer fra de kontinuerlige kamlydes ophør til lydens ophør (selve spillet slutter først, når fuglen har samlet halen – dette sker 1,5–3 sekunder efter at den er blevet tavs (se Fig. 9)). Motivet varer ca. 1 sekund og høres som et langtrukkent vii-vi. Sektionen deles i 2 motiver og grænsen mellem disse 2 motiver er sat, hvor den store komplekse tone med overtonerne begynder.

Sektion II motiv 1.

Det første af disse motiver består af nogle komplicerede figurer, der går stejlt op og ned, og en af disse figurer har som det højeste punkt en frekvens på 4 KHz. Ind imellem er der enkelte kamlyde. Motivet har på spektrogrammet en meget konstant længde på 0,25 sekund.

Ved dette motivs start begynder fuglen nogle hurtige og komplicerede stillingsændringer, der ses som stilling 5 på fig. 9. Disse ændringer er ikke helt afsluttet ved overgangen til det næste motiv.

Stillingsændringerne indledes med at halen sænkes og spredes maksimalt ud og drejes til siden, så de yderste hvide halefjer ses tydeligt. (I skumringen er det dette, der ses tydeligst af fuglen), derefter slår fuglen et slag med vingerne. Under dette slag holdes vingen bøjet i albueled og noget bøjet i håndleddet. Næbbet rettes fremad og åbnes ca. 20° et kort øjeblik.

Sektion II motiv 2.

Motiv 2 er de sidste lyde i spillet, men »spillestillingen« afsluttes først senere når halen samles, 1,5–3 sekunder efter lydene er ophørt. Hele motivet ses på spektrogrammet som en stor buet figur efterfulgt af fra 2–4 små figurer.

Fra stilling 5, som er beskrevet ovenfor, forandres fuglens stilling i dette motiv successivt til afslutningsstillingen i spillet (stilling 6) som den indtager når lydytringerne helt er ophørt. Næbbet er lukket og strækkes opad i vinkel på 45°, vingerne holdes ind til kroppen, halen samles langsomt – og stil-

lingen ligner så stillingen som fuglen indtager i begyndelsen af spillet (stilling 3).

Lydene mellem spillene (mellemspillet).

På det tidspunkt, hvor spillet er på sit højeste (omkring midnat) er der selv mellem bølgerne af spil ikke tavshed på spillepladsen, men der høres en konstant svag sangeragtig kvidren fra hele pladsen. Dette har jeg kaldt mellemspillet, og en spektrografisk analyse af dette mellemspil ses på fig. 11. Dette mellemspil består af simple figurer, der i tonehøjde ligger mellem 2 og 4,5 KHz, og hvor figurernes form minder meget om figurerne i sektion 1, motiv 1, men i mellemspillet kommer figurerne i et konstant tempo med 6–9 figurer pr. sek. Under mellemspillet indtager fuglen hvilestillingen, som er aftegnet som stilling 2.

Når dette mellemspil er mest intenst, åbnes og lukkes næbbet på samme måde som i sektion 1 i takt med figuren. Muligvis er det, når kamlydssegmenterne forekommer, idet disse ses på spektrogrammet (fig. 11).

Tredækkerens spektrogram er et meget kompliceret spektrogram, særligt sammenlignet med mange af sangfuglenes, og mange detailler er udeladt. Der er en række variationer i spektrogrammet, som sandsynliggør, at den enkelte fugl har sit særlige »spektrografiske billede«, som næppe er hørbart for mennesket.

Ialt er 8 spilleperioder analyseret og 5 af disse er fra een fugl i Lapland og 2 af disse er fra en fugl i Jämtland; ved sammenligning af disse to fugles spektrogrammer finder man, at der er visse forskelle, bl. a. i »vi-vi«-lydens udseende, samt spilleperiodens længde.

En sådan forskel i ikke hørbare detailler på spillepladsen fra individ til individ er påvist hos adskillige fuglearter i de senere år (Borror (Layon W. E., 1960, p. 35)) og denne forfatter karakteriserer dette forhold på følgende måde: »The graphs are like a signature they are characteristic for individual bird«.

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