Chorthippus jutlandica sp. nov. – a new grasshopper found in Jutland, Denmark (Saltatoria, Acrididae, Gomphocerinae)

Ole Fogh Nielsen

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Studies of and observations on the grasshopper fauna in dune areas in West Jutland have surprisingly revealed a new, unknown gomphocerine species. The grasshopper, which was registered for the first time in 1992, is very similar to *Chorthippus biguttulus* (Linnaeus, 1758). Studies carried out in 2001 show, however, that the species – both regarding stridulation and morphology – differs so markedly from *Chorthippus biguttulus* that it must be considered a new species – here described as *Chorthippus jutlandica* sp. nov. The best way to distinguish the two species is by means of their songs. The differences between the calling song and the courtship song of the two species are very striking, and singing males are usually easily identified. Identification based on morphology is more difficult. Usually males of the two species may be separated by means of differences in the appearance of the fore wing, especially its shape, and the appearance of the subcostal area. Also identification based on comparison of two or more morphological measurements is most often possible. However, a certain overlap is found in most characters, and individuals may probably be found which cannot be identified safely by means of morphological data. Therefore identification ought to be based on both song and morphology, if possible. So far only males have been used in morphological measurements. Future studies will show whether it is also possible to find decisive differences between the females. Besides the differences in song and morphology it is worth to note that *C. jutlandica* and *C. biguttulus* do not occur in the same areas in Denmark. *C. jutlandica* can only been recorded from coastal dune areas in West Jutland, whereas *C. biguttulus* has only been found in East and North Jutland and on the islands east of Jutland.

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Introduction

Chorthippus biguttulus was the first-named member of a complex of several closely related species referred to as the *biguttulus* species-group. *C. biguttulus* was described by Linnaeus in 1758, and in the beginning of the nineteenth century two more members of the species-group were described, i.e., *C. brunneus* (Thunberg, 1815) and *C. mollis* (Charpentier, 1825). The three species are very similar morphologically, therefore often confused, and for a long time many authors were of the opinion that only one very variable species – named *C. variabilis* – was involved. However, Ramme (1921) – particularly based on studies of the songs – firmly established the three 'classical' species: *C. brunneus*, *C. mollis*, and *C. biguttulus*.

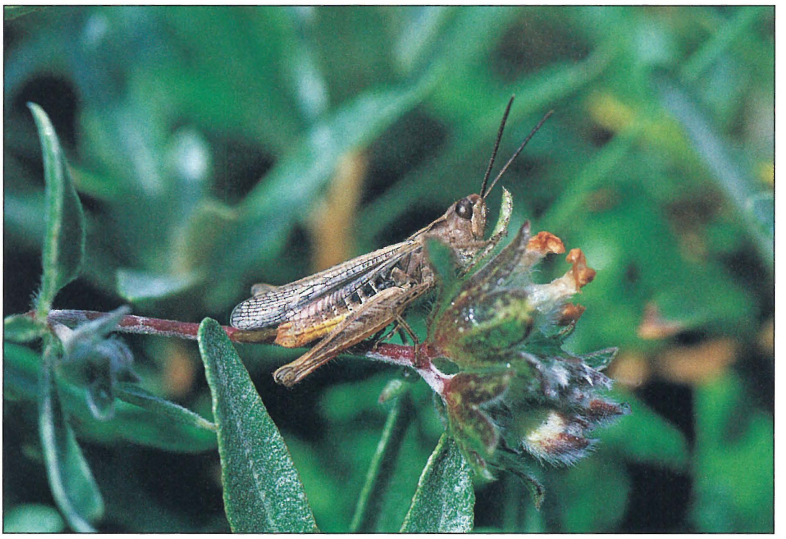

Fig. 1. *C. jutlandica*, male – West Jutland, Klitsø near Vejers, 20-7-2001. Photo: Ole Fogh Nielsen.

Subsequently, a number of new species have been separated from the three above mentioned species – again particularly by means of song analyses. In the western part of Europe there is at present relative clarity about species identification, but in the south-eastern part of Europe – including Russia – where there probably are an additional couple of species, the situation is more unclear (Bukhvalova, 1995, 1999). Therefore material and studies from the last-mentioned area are not included in the present work.

Based on differences in stridulation and morphology, the *biguttulus* species-group in western Europe is differentiated into two lines – a *brunneus/mollis*-line and a *biguttulus*-line.

The *biguttulus*-line, which is the one of interest here, includes *C. biguttulus*, which is widespread in great parts of North and Central Europe, and the following three species:

C. yersini Harz, 1975, which replaces *C. biguttulus* in the Iberian Peninsula and on Sicily (Harz, 1975; Ragge & Reynolds, 1988),

C. rubratibialis Schmidt, 1978, which replaces *C. biguttulus* in Italy (Schmidt, 1978), and

C. eisentrauti, Ramme, 1931, which can be found in the southern Alps (Ramme, 1931; Ingrisch, 1995).

The three last mentioned species differ from *C. biguttulus* both concerning song and appearance. *C. biguttulus* and *C. eisentrauti* are found sympatrically in a very small area in the Alps, but otherwise their distribution areas do not overlap (Ingrisch, 1995; Ragge & Reynolds, 1998).

The grasshopper which is the subject of this article was registered for the first time in the dunes near Vejers in West Jutland on June 23, 1992. At first it was identified as *C. biguttulus*, but it soon became evident that the individuals from West Jutland differed from typical *C. biguttulus* both concerning song and morphology. A few individuals were collected and recordings were made in 1996 and in 2000, but a more thorough study with the purpose of solving the identification did first take place in the summer of 2001.

The results of this study was that we were dealing with a new Gomphocerinae: *Chorthippus jutlandica* sp. nov., which like the above mentioned species must be considered an additional member of the *biguttulus*-line.

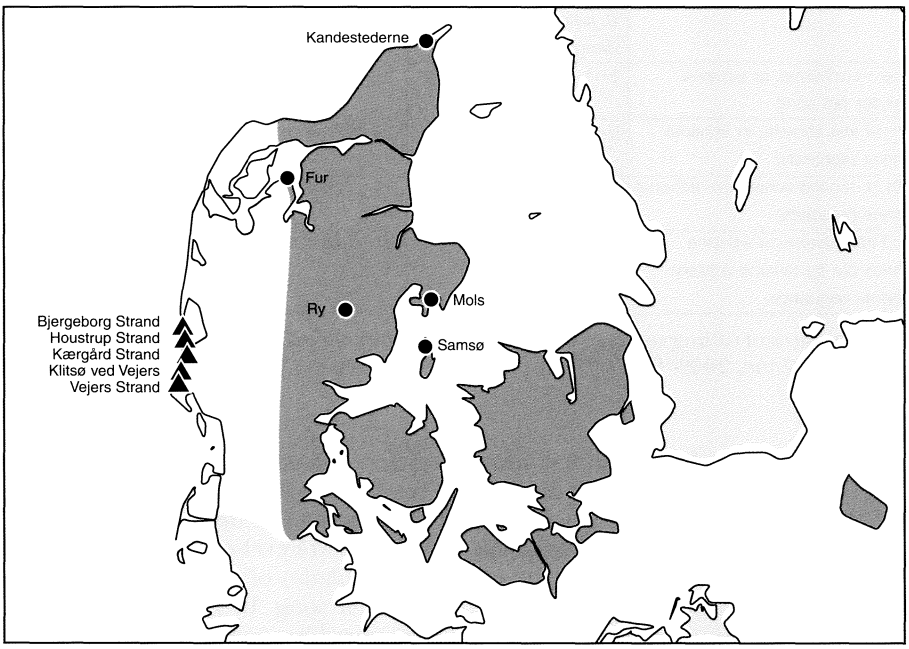

Fig. 2. Map showing the localities of recording and collecting of *C. jutlandica* ▲ and *C. biguttulus* ● together with the distribution of *C. biguttulus* (shaded) in Denmark.

In Denmark, *C. biguttulus* is widespread on the islands east of Jutland and in East and North Jutland, but is missing in West Jutland and in the western part of Mid-Jutland (Holst, 1969; Fogh Nielsen, 1993, 2000). *C. jutlandica* has only been found in the coastal areas of West Jutland, and so far it seems that the two species in Denmark are totally separated by a zone more than 80 kilometres wide.

Methods

The description of *C. jutlandica* is based on both analyses of songs and morphological measurements. Among the almost identically appearing grasshoppers in the *biguttulus*-group the calling song functions as an effective isolation factor, which usually prevents mating between different species. Analyses of and comparisons between the songs are therefore a very essential supplement to traditional morphological measurements (Ragge & Reynolds, 1988, 1998). All recordings were made in nature on the habitats of the grasshoppers. Afterwards attempts were made to catch the males, which succeeded in 2 out of 3 attempts. Specimens were only collected after recordings had been made. This means that there are song recordings corresponding to all collected males.

Specimens have been collected and recordings made at 5 localities in West Jutland: Vejers, Klitsø v. Vejers, Kærgård Strand, Houstrup Strand og Bjergeborg Strand plus from 5 localities in East and North Jutland: Ry, Mols, Samsø, Fur and Kandestederne (Fig. 2).

From the localities in West Jutland 32 individuals have been collected, and recordings have been made of the songs of 52 males. From the localities in East and North Jutland 37 individuals have been collected and recordings have been made of the songs of 56 males. With a few exceptions all the specimens collected are males, and only males have been used for morphological measurements, because the females of the *biguttulus* spe-

	C. jutlandica				*C. biguttulus*				Significance
	Range	Mean	S.D.	N	Range	Mean	S.D.	N	P<
Number of echemes or echeme sequences per song	3-11	6.29	1.901	21	2-5	3.25	0.686	44	0.001
Length of first echeme or echeme sequence (seconds)	0.41-0.86	0.66	0.136	21	1.44-3.31	2.30	0.401	44	0.001
Length of second echeme or echeme sequence (seconds)	0.40-0.96	0.66	0.150	21	1.30-2.40	1.80	0.250	44	0.001
Index: First echeme or echeme sequence div. by second echeme or echeme sequence	0.85-1.35	1.01	0.112	21	1.06-1.66	1.28	0.158	44	0.001

Table 1. Measures of calling songs of males of *C. jutlandica* and *C. biguttulus*. All songs were recorded in full sunshine, 20-25°C. Significances are from two-tailed Mann-Whitney U-tests.

cies-group are so much alike that comparisons here would hardly deliver useful information. Songs from 108 different males have been collected, and most of them are included in the analyses. Only a small number of songs had to be left out, being incomplete or fragmentary; e.g., the singing male was disturbed by other grasshoppers or other insects. It was also quite usual that the wind carried blades of grass or flowers onto the stridulating individuals and thereby interrupted their song. By far most of the recordings collected are calling songs, but a number of courtship songs and a few rivalry songs are part of the study material as well.

Over the years many different systems and terminologies have been used to describe and characterise the grasshoppers' songs. In this study the following terms are used:

Syllable: the sound produced by an up- and downstroke movement of the hindleg.

Echeme: a first-order assemblage of syllables.

Echeme-sequence: a first-order assemblage of echemes.

The recordings were made with a Sony Walkmann Professionel WM-D6C casette recorder, and a Beyerdynamic directional microphone. The recordings were transferred to a computer, and the sound analyses were made in the sound programme, GoldWave.

The morphological measurements were made by means of a Gundlach stereo-microscope with a micrometer. Statistical tests are non-parametric two-tailed Mann-Whitney U-tests.

Material

The locations of recordings and collecting are as follows (Fig. 2):

C. jutlandica: Vejers (WJ, MG 46), 16 July 2001: 6 males. – Bjergeborg Strand (WJ, MG 49), 17 July 2001: 2 males. – Houstrup Strand (WJ, MG 48), 17 July 2001: 1 male. – Kærgård Strand (WJ, MG 47), 17 July 2001: 3 males. – Klitsø near Vejers (WJ, MG 46), 20 July 2001: 6 males. – Vejers (WJ, MG 46), 24 August 2001: 2 males. – Vejers (WJ, MG 46), 25 August 2001: 9 males and 2 females.

C. biguttulus: Ry (EJ, NH 41), 23 July 2001: 2 males. – Ry (EJ, NH 41), 24 July 2001: 6 males. – Mols, Trehøje (EJ, NH 93), 26 July 2001: 9 males. – Fur (NWJ, NH 09), 29 July 2001: 6 males. - Samsø, Møgelskår (EJ, NH 90), 11 August: 8 males. – Kandestederne (NEJ, NJ 89), 15 August 2001: 6 males.

All grasshoppers collected – in total 67 males and 2 females – and a CD with the calling songs analysed and their data are deposited with Naturhistorisk Museum, Århus, Denmark.

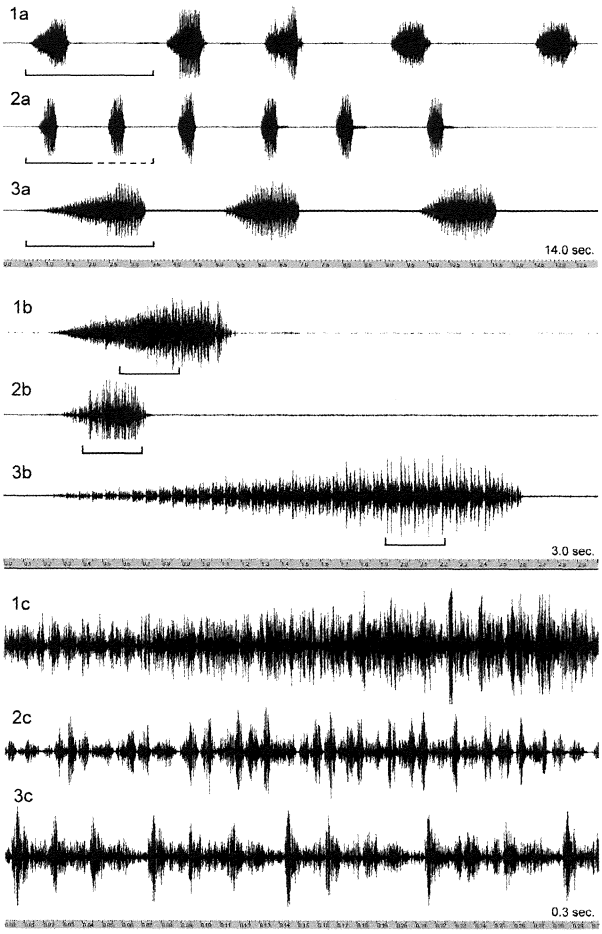

Fig. 3. Oscillograms of male calling songs of *C. jutlandica* and *C. biguttulus*. – 1a, b, c: *C. jutlandica* (Vejers, 20-7-2001, full sunshine, 20°C). 2a, b, c: *C. jutlandica* (Vejers, 25-8-2001, full sunshine, 23°C). 3a, b, c: *C. biguttulus* (Ry, 23-7-2001, full sunshine, 23°C). Framed ports in a are magnified in b, and framed ports in b are magnified in c.

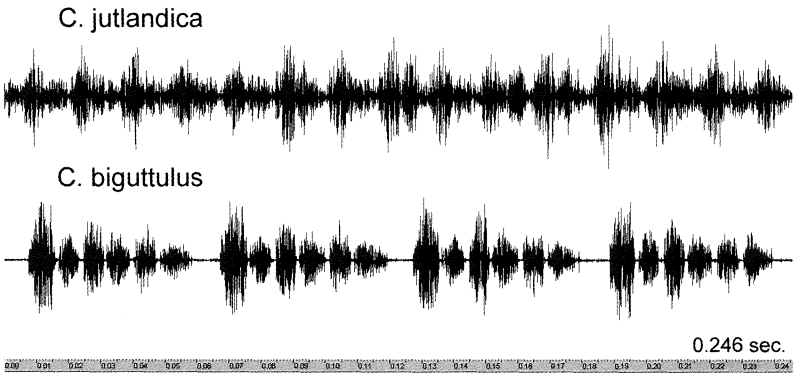

Fig. 4. Oscillograms of parts of male calling songs of *C. jutlandica* (Vejers, 25-8-2001, full sunshine, 23°C) and *C. biguttulus* (Kandestederne, 15-8-2001, full sunshine, 22°C). Both songs are from males with only one hind leg, thus showing more clearly the contrasts in the rhytmic pattern between the calling songs of the two species.

Results

Songs. Table 1 summarises the song measurements.

C. jutlandica's calling song is approximately 10-20 seconds long and consists of a varied number of elements, which are sometimes echemes consisting of a great number of uniform very dense syllables, and at other times irregular echeme-sequences consisting of 5-15 echemes made up by a rather varied number of syllables.

The vast majority of the calling songs consists of 5, 6 or 7 echemes or echeme-sequences (average: 6.29), but also calling songs with 3, 4, 8, 9, 10 and 11 echemes or echeme-sequences have been registered.

The individual echemes or echeme-sequences are very short and last between 0.40 and 0.96 seconds (average 0.66 seconds). The first echeme or echeme-sequence is sometimes longer than the following echemes or echeme-sequences, at other times shorter (average: 1:1.01).

Like the calling song the courtship song of *C. jutlandica* consists of a varied series of short echemes or echeme-sequences. The two types of songs are so similar that it is hardly possible to hear or measure the difference. It is necessary to know the position of the male in relation to the female, in order to categorise a song belonging to one or the other of the two types.

The rivalry song consists of approximately 0.5 seconds long echemes or echeme-sequences. When two males are interacting, their rivalry songs are often heard as regular alternating echemes or echeme-sequences. The individual echemes or echeme-sequences of the rivalry song are often almost undistinguishable from the echemes or echeme-sequences of the calling song or the courtship song.

The calling song of *C. biguttulus* is approximately 7-14 seconds long and consists of 2-5 echeme-sequences. Each echeme-sequence consists of a great number of regular echemes, each of which usually consists of 3 syllables.

Most calling songs consist of 3 echeme-sequences, but calling songs consisting of 4 echeme-sequences are also quite common. A few calling songs with 2 or 5 echeme-sequences have been registered as well (average: 3.25).

The first echeme-sequence is always clearly longer than the following echeme-sequences and lasts between 1.44 and 3.31 seconds (average: 2.30 seconds). The second echeme-sequence lasts between 1.30 and 2.40 seconds (average: 1.80 seconds).

The courtship song of *C. biguttulus* consists of one or more echeme-sequences, which is similar to the first echeme-sequence of the calling song. However, the courtship song usually starts in a more hesitating way. It has a softer and weaker sound and is often followed by series of quieter syllables – a so-called aftersong. The courtship song typically lasts between 2.50 and 6.00 seconds. Recordings of a potential rivalry song have not been made.

Comparisons of songs

The calling songs and courtship songs of *C. jutlandica* and *C. biguttulus* are significantly different concerning the following points (Fig. 3, Fig. 4, Table 1):

1. The songs of *C. jutlandica* consist of a considerably greater number of echemes or echeme-sequences. Overlap between the two species does occur, however.

2. The structures of the echemes or echeme-sequences of the two species are markedly different. The elements of the songs of *C. jutlandica* are sometimes echemes consisting of a great number of very dense uniform syllables, at other times irregular echeme-sequences consisting of echemes with a varied number of syllables. The songs of *C. biguttulus* always consist of echeme-sequences of regular and uniform echemes, each of which usually consists of 3 syllables.

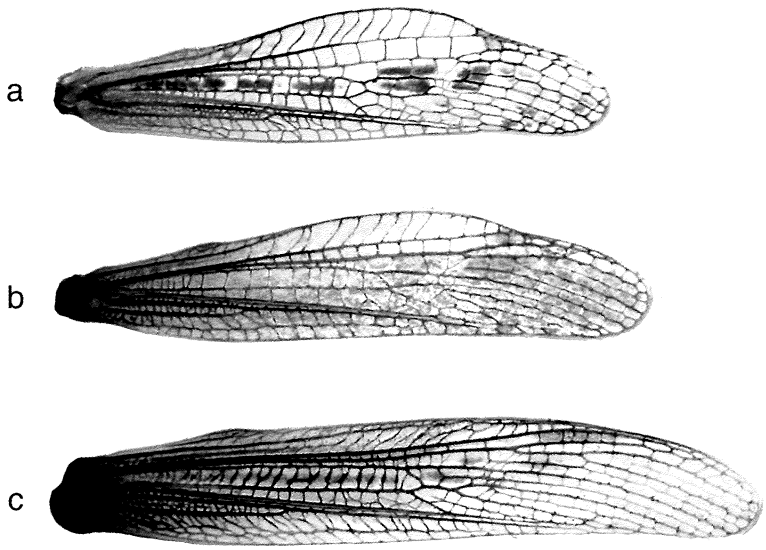

Fig. 5. Right tegmen of: a: *C. biguttulus*, male (Fur, 29-7-2001), b: *C. jutlandica* male, holotype (Vejers, 24-8-2001) and c: *C. jutlandica*, female, paratype (Vejers, 25-8-2001). Photos: Jens Kirkeby.

3. The echemes or echeme-sequences of the calling song and the courtship song of *C. jutlandica* are of very short duration (0.40-0.96 seconds), while the echeme-sequences of the calling song of *C. biguttulus* are much longer (1.30-3.31 seconds). The echeme-sequences of the courtship song are on average even longer and last approximately between 2.50 and 6.00 seconds.

4. The echemes or echeme-sequences of the calling song of *C. jutlandica* are on average of equal duration. The first echeme-sequence of the calling song of *C. biguttulus* is always clearly of longer duration than the other echeme-sequences.

The stridulatory movements of the grasshoppers are dependent on temperature. The warmer it is, the faster the grasshoppers sing. Therefore the descriptions and data above are all based on songs recorded in full sunshine and at a minimum temperature of 20°C.

In cloudy, cold and windy weather the songs are somewhat longer. Here the echemes or echeme-sequences of the calling song of *C. jutlandica* last between 0.44 and 1.29 seconds, and the echeme-sequences of the calling song of *C. biguttulus* between approximately 2.50 and 6.00 seconds.

Morphology

Morphologically *C. jutlandica* is very similar to *C. biguttulus*, but the males of the two species may usually be identified by means of the following difference in the appearance of the tegmen:

C. jutlandica: costal and subcostal areas moderately expanded, gradually restricted at the constriction of costa and subcosta, resulting in a slightly bowed anterior margin. Tegmen "normal". Subcostal area regularly and gradually widened from the base towards the apical constriction. Width of costal and subcostal areas normally less than 1.0 mm (Fig. 5b).

C. biguttulus: costal og subcostal areas strongly expanded, then suddenly restricted at the constriction of costa og subcosta, resulting in a markedly bowed anterior margin. Tegmen thus of a characteristic and unique appearance. Subcostal area suddenly wid-

	C. jutlandica				*C. biguttulus*				Significance
	Range	Mean	S.D.	N	Range	Mean	S.D.	N	P<
Tegmen length (mm)	11.9-13.8	12.71	0.475	30	10.5-13.6	12.08	0.633	37	0.001
Tegmen width (mm)	2.4-3.0	2.66	0.148	30	2.4-3.1	2.73	0.175	37	n. s.
Tegmen length : width	4.34-5.25	4.80	0.253	30	3.89-5.16	4.436	0.262	37	0.001
Combined width of costal and subcostal areas (mm)	0.8-1.1	0.93	0.065	30	0.9-1.2	1.08	0.077	37	0.001
Combined width of costal and subcostal areas div. by tegmen width (%)	32.00-37.50	34.814	1.396	30	36.00-42.59	39.528	1.448	37	0.001
Combined width of costal and subcostal areas div. by tegmen length (%)	6.45-8.39	7.28	0.469	30	7.87-10.95	8.941	0.606	37	0.001
Postfemur length (mm)	8.4-9.8	9.13	0.308	30	7.7-8.9	8.33	0.318	34	0.001
Stridulatory file length (mm)	2.8-4.0	3.34	0.298	27	2.4-3.5	3.04	0.300	32	0.001
Number of stridulatory pegs	79-116	99.3	10.175	27	74-119	101.2	10.39	32	n. s.
Number of stridulatory pegs per mm	25.5-33.6	29.7	1.743	27	28.1-41.4	33.41	2.560	32	0.001
Length of body (mm)	12.3-14.4	13.49	0.516	30	11.1-14.0	12.88	0.653	36	0.001

Table 2. Morphometrical data for males of *C. jutlandica* and *C. biguttulus*. Significances are from two-tailed Mann-Whitney U-tests.

ened, remaining of equal width until the apical constriction. Width of costal and subcostal areas normally exceeding 1.0 mm (Fig. 5a).

Furthermore *C. jutlandica* is slightly larger with narrower wings than *C. biguttulus*. However, there is great individual variation in both species, and identification based on a single character is in many cases problematic. Therefore identification based on a combination of two or more measurements is usually necessary to ensure identification of individual specimens (Table 2).

Identification within the *biguttulus*-line using morphological characters is in general difficult. The morphological similarities combined with individual variation cause overlapping regarding most characters. Therefore exact identification entirely based on morphological data is not always possible.

Description

Chorthippus jutlandica sp. nov.
Holotype: male, Vejers, Denmark (UTM: WJ, MG 46), 24 August 2001.
Paratypes: Vejers, Denmark (UTM: WJ, MG 46), 25 August 2001: 2 females. – Vejers, Denmark (UTM: WJ, MG 46), 16 July 2001: 6 males. – Bjergeborg Strand, Denmark (UTM: WJ, MG 49), 17 July 2001: 2 males. – Houstrup Strand, Denmark (UTM: WJ, MG 48), 17 July 2001: 1 male. – Kærgård Strand, Denmark (UTM: WJ, MG 47), 17 July 2001: 3 males. – Klitsø near Vejers, Denmark (UTM: WJ, MG 46), 20 July 2001: 7 males. – Vejers, Denmark (UTM: WJ, MG 46), 24 August 2001: 2 males. – Vejers, Denmark (UTM: WJ, MG 46), 25 August 2001: 9 males.

All specimens: Ole Fogh Nielsen leg., coll. Naturhistorisk Museum, Århus, Denmark.

Description of male (Holotype):
Ratio least width of vertex:length of eye: 1:2.1. Foveolae distinct, rectangular and 3 times as long as wide. Frontal ridge with parallel sides above medial ocellus, diverging towards clypeus. Antennae filiform with 24 segments. Length of antennae 7.8 mm. Longest segment 2.4 times as long as wide.

Side keels of pronotum angularly incurved. Median keel prominent. Ratio pronotum A:B:C: 1.5:1:2.2 (see Fig. 6). Length of pronotum 2.7 mm. Ratio prozona:pronotum: 0.44:1. Tegmen (Fig. 5b) extending beyond abdominal apex and reaching hind knee. Trans-

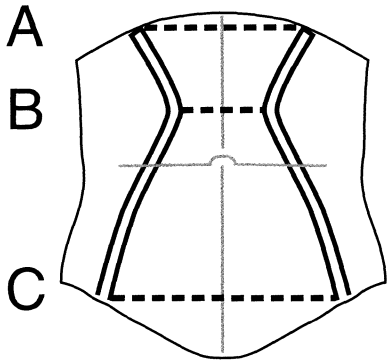

Fig. 6. Pronotum in dorsal view. (Skematic drawing). Lines at A, B, C indicate measures used in the morphological description.

parent, colourless with brown veinlets. Medial area and area near stigma without dark spots. Length of tegmen 12.5 mm. Ratio width of tegmen:length of tegmen: 1:4.8. Precostal area rather widened near base, costal area distinctly widened, subcostal area gradually widened from base to the apical constriction. Combined costal and subcostal areas 0.9 mm. Distance from the middle of stigma to apex 4.5 mm. Alae slightly shorter than tegmen, colourless and transparent. Cerci conical, rounded apically. Epiproct triangular. Posttibia with 13 black spines on the outside dorsally and 12 black spines on the inside dorsally. Length of postfemora 9.2 mm. Postfemora 4.6 times as long as high. Length of stridulatory file 3.4 mm. Ratio length of postfemora:stridulatory file: 2.7:1. Number of stridulatory pegs: 102. Number of stridulatory pegs per mm: 30. Length of body 12.8 mm. Opening of tympanal organ 5.3 times as long as wide.

Description of female (Paratype):
Ratio least width of vertex:length of eye: 1:1.7. Foveolae rectangular and 2.5 times as long as wide. Frontal ridge with parallel sides above medial ocellus, diverging towards clypeus. Antennae filiform with 24 segments. Length of antennae 7.9 mm. Longest segment 2.5 times as long as wide.

Side keels of pronotum angularly incurved. Median keel prominent. Ratio pronotum A:B:C: 1.7:1:2.8 (see Fig. 6). Length of pronotum 3.6 mm. Ratio prozona:pronotum: 0.44:1. Tegmen (Fig. 5c) extending to abdominal apex and reaching hind knee. Transparent, colourless with brown veinlets. Tegmen without dark spots. Length of tegmen 14.8 mm. Ratio width of tegmen:length of tegmen: 1:6.1. Precostal area well widened near base. Costal area moderately widened. Subcostal area narrow. Combined precostal, costal and subcostal areas 0.75 mm. Distance from the middle of stigma to apex 5.6 mm. Alae slightly shorter than tegmen, colourless and transparent. Length of postfemora 12.1 mm. Postfemora 4.7 as long as high. Length of stridulatory file 4.3 mm. Ratio length of postfemora:stridulatory file: 2.8:1. Number of stridulatory pegs 78. Number of stridulatory pegs per mm: 18.1. Length of body 18.4 mm. Opening of tympanal organ 6.7 times as long as wide.

Etymology

C. jutlandica has been named after Jutland.

Fig. 7. Habitat of *C. jutlandica* – Klitsø near Vejers, 20-7-2001. Photo: Ole Fogh Nielsen.

Distribution and habitat

C. jutlandica has so far only been found along the western coast of Jutland, where it has been registered at a number of localities between Vejers Strand and Bjergeborg Strand north of Nymindegab. It seems that the species is only to be found in warm, sparsely vegetated dunes quite close to the coast (Fig. 7). Here it is usually abundant and clearly the most common grasshopper. Few other orthopterans, namely *Decticus verrucivorus* (Linnaeus, 1758) and *Myrmeleotettix maculatus* (Thunberg, 1815) are fairly abundant as well, whereas species like *Omocestus viridulus* (Linnaeus, 1758), *C. brunneus*, *C. albomarginatus* (De Geer, 1773) and *C. parallelus* (Zetterstedt, 1821) only appear sporadically at this type of locality.

Attempts at finding *C. jutlandica* on heaths and at other potential localities further inland have so far been unsuccessful.

C. jutlandica has been registered from 12 June until 25 August. However, attempts at finding the species later have not been made, and it is quite possible that it can be found both in September and primo October.

Dansk resumé

Som et resultat af undersøgelser foretaget i sommeren 2001 på en række lokaliteter i Jylland, Danmark beskrives her en ny markgræshoppe: *Chorthippus jutlandica* sp. nov.. Arten minder umiddelbart meget om *Chorthippus biguttulus*, men sammenligninger baseret på både analyser af sange og morfologiske målinger viser, at *C. jutlandica* må betragtes som en selvstændig art – nært beslægtet med *C. biguttulus* og uden tvivl tilhørende den såkaldte *biguttulus*-linje.

Den mest sikre måde at adskille de to arter på er ved hjælp af sangen. Forskellen mellem både kaldesangen og friersangen er markant, og syngende hanner vil normalt kunne artsbestemmes uden problemer.

Bestemmelse baseret på morfologi er mere vanskelig. Normalt kan de to arters han-

ner adskilles ved hjælp af forskelle i forvingens udseende – især forvingekantens udformning og subcostalfeltets udseende – ligesom adskillelse baseret på en sammenligning af to eller flere morfologiske målinger oftest er mulig. Der er dog en vis overlapning med hensyn til de fleste karakterer, og man vil sandsynligvis kunne træffe individer, der ikke vil kunne bestemmes sikkert udelukkende ved hjælp af morfologiske data. Artsbestemmelse bør derfor altid baseres på både sang og morfologi, hvis det på nogen måde er muligt.

Hunnerne hos arterne i *biguttulus*-linjen ligner hinanden uhyre meget, og der er indtil videre kun anvendt hanner i forbindelse med de morfologiske målinger. Kommende undersøgelser vil vise, om det også er muligt at konstatere afgørende forskelle mellem de to arters hunner.

Udover forskelle med hensyn til sang og morfologi, er det værd at bemærke, at *C. jutlandica*'s og *C. biguttulus*' forekomstområder ikke overlapper i Danmark. *C. jutlandica* er kun registreret i kystnære klitområder i Vestjylland, mens *C. biguttulus* udelukkende er fundet på Øerne og i Øst- og Nordjylland (Fig. 2).

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References

Bukhvalova, M. A., 1995. The song and morphological characters of some grasshoppers of the *Chorthippus biguttulus* group (Orthoptera, Acrididae) from Russia and adjacent territories. – *Entomological Review* 74: 56-67.

Bukhvalova, M. A., 1999. New data on taxonomy of species of the *Chorthippus biguttulus* group (Orthoptera, Acrididae) from Russia and adjacent territories. – *Entomological Review* 78: 867-875.

Fogh Nielsen, O., 1993. Markgræshoppen *Chorthippus biguttulus* (Linnaeus, 1758) (Orthoptera, Acrididae) fundet i gamle moler-grave på Fur. – *Entomologiske Meddelelser* 61: 116.

Fogh Nielsen, O., 2000. *De danske græshopper.* Apollo Books. Stenstrup, 191 pp.

Harz, K., 1975. Die Orthopteren Europas. The Orthoptera of Europe. Vol II. – *Series Entomologica* 11. The Hague, 939 pp.

Holst, K. Th., 1969. The distribution of Orthoptera in Denmark, Scania and Schleswig-Holstein. – *Entomologiske Meddelelser* 37: 413-442.

Ingrisch, S., 1995. Evolution of the *Chorthippus biguttulus* group (Orthoptera, Acrididae) in the Alps, based on morphology and stridulation. – *Revue Suisse Zoologie* 102: 475-535.

Ragge, D. R. & Reynolds, W. J., 1988. The songs and taxonomy of the grasshoppers of the *Chorthippus biguttulus* group in the Iberian Peninsula (Orhoptera, Acrididae). – *Journal of Natural History* 22: 897-929.

Ragge, D. R. & W. J. Reynolds, 1998. *The Songs of the grasshoppers and crickets of western Europe.* – Harley Books. London, 591 pp.

Ragge, D. R. & W. J. Reynolds, 1998. *A sound guide to the grasshoppers and crickets of western Europe.* (2 CD set: 170 species – 120 minutes). – Harley Books. London.

Ramme, W., 1921. Orthopterologische Beiträge. – *Arkiv für Naturgeschichte* Abt. A, 86(12): 81-166.

Ramme, W., 1931. Beiträge zur Kenntnis der palaearktischen Orthopterenfauna (Tettig. et Acrid.). – *Mitteilungen aus dem Zoologischen Museum in Berlin* 17: 165-200.

Schmidt, G. H., 1978. Ein Beitrag zur Taxonomie von *Chorthippus (Glyptobothrus) biguttulus* L. (Insecta: Saltatoria: Acrididae). – *Zoologischer Anzeiger* 201: 245-259.