

**Behaviour-related Microhabitat Utilization in *Chorthippus apricarius* (LINNÉ, 1758) and
Chorthippus biguttulus (LINNÉ, 1758)**

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Abstract: Behaviour-related Microhabitat Utilization in *Chorthippus apricarius* (LINNÉ, 1758) and *Chorthippus biguttulus* (LINNÉ, 1758)

In the state of Bremen two thermophilous grasshopper species occur at dry fringes, *Ch. apricarius* and *Ch. biguttulus*. We addressed the question, whether competition between the two species might exist, or whether they differ in microhabitat utilization. The results showed that both species do not necessarily co-occur. While *Ch. apricarius* occurs at the edge of ditches in the wet meadows north of Bremen, *Ch. biguttulus* is found here only rarely and does not seem to be indigenous. Some reasons were found in the different microhabitat utilization. *Ch. apricarius* was found during all behaviour patterns more often on forbs and litter than *Ch. biguttulus*, which used grasses in high proportion. *Ch. apricarius* was also found in denser and higher vegetation, although it was usually located lower than *Ch. biguttulus*. A high proportion of the specimens was found in horizontal position, while *Ch. biguttulus* was often found in vertical position. This is in clear contrast to other phytophilous species. We also found *Ch. apricarius* feeding at *Urtica dioica*, showing that the species is not exclusively graminivorous, which seems to be true for *Ch. biguttulus*. In both species, females were often found resting or basking, while males of both species invested a substantial part of their time in singing. Due to their different microhabitats, the species either avoid competition or do not exhibit any competition at all.

Key words: niche competition, conservation, microhabitat, thermoregulation, sex-specific differences

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The occurrence of grasshopper species in certain habitats is mainly determined by their requirements to microclimate (Ingrisch 1983) and vegetation (Sänger 1977). Thus grasshopper assemblages are influenced by abiotic and biotic factors, allowing all species of an assemblage to exist in time and space. Niche competition has usually not been considered to be a substantial factor for grasshoppers, although this has been assumed by Ingrisch (1981) for the katydids *Tettigonia viridissima* (LINNÉ, 1758) and *Tettigonia cantans* (FUESSLY, 1775) and by Buchweitz et al. (1990) for *Chorthippus apricarius* and *Ch. biguttulus*. The question arises, how syntopous species with a high niche overlap manage to persist in time and space? A possible mechanism of competition avoidance is the choice of different microhabitats (Hochkirch 1995), which actually means that syntopous occurrence is a matter of scale and grasshopper assemblages do not exist, if the smallest scale is chosen. In the state of Bremen, two closely related grasshopper species occur at edges of roads and ditches, *Chorthippus biguttulus* and *Chorthippus apricarius* (Hochkirch & Klugkist 1998). Both species are generally regarded as thermo- and xerophilous (Bellmann 1993). Although both species have been frequently observed in the Blockland (a wet meadow area in the north of Bremen), only *Ch. apricarius* seems to be indigenous here. *Ch. biguttulus* immigrates into the area without any successful reproduction (Hochkirch in press). While *Ch. apricarius* is rare in large parts of western Germany (Detzel 2001), but very common in Bremen (Hochkirch & Klugkist 1998), *Ch. biguttulus* is generally widespread in Germany. Our main research objectives were to find solutions for their different occurrence in the behaviour-related microhabitat utilization.

Method

The practical fieldwork was performed from 13 July to 19 September 2000 at four study sites in the Blockland and near the University of Bremen. From both areas the two species have been recorded in the 1990s. In 2000 both species were present at two study sites (University), while at the other two sites only *Ch. apricarius* was found. Continuous behaviour observations were made, trying to observe single specimens as long as possible. Abiotic and biotic parameters were recorded synchronously (date, time, temperature, insolation, shade, location of the specimen, height of location, vegetation height, vegetation cover). χ^2 cross-tabulation tests were used to test nominal data (Precht 1979). Mann-Whitney U-tests adjusted for large sample size were used to test metric data (Sachs 1974). The highest accepted P was 0.05.

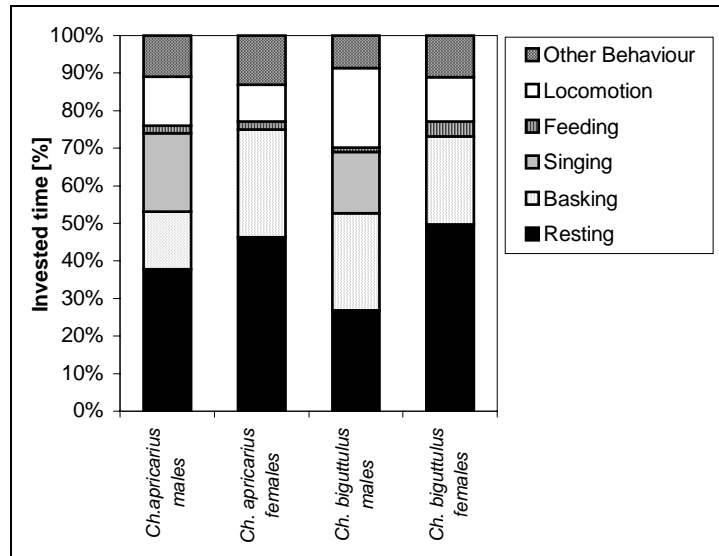


Fig. 1: Behaviour records of males and females of both species. In both species the males show more activities than the females, due to singing and locomotion.

Results

A total of 58 specimens was recorded in 2541 single records from 42 h 13 min. Both species and sexes showed significantly differing behaviour (χ^2 test, DF = 5, Fig. 1). Males were more active due to singing and locomotion, while females were resting and basking more often. Other behaviour includes cleaning, courtship, copulation, oviposition, leg movements, defecation etc. The locations occupied by the two species during different behaviour differed significantly (Figs. 2-5). Generally *Ch. biguttulus* males were found more often on grasses than *Ch. apricarius* males, while *Ch. apricarius* used more often forbs and litter. *Ch. biguttulus* females used more often litter, while *Ch. apricarius* females were found more often on forbs.

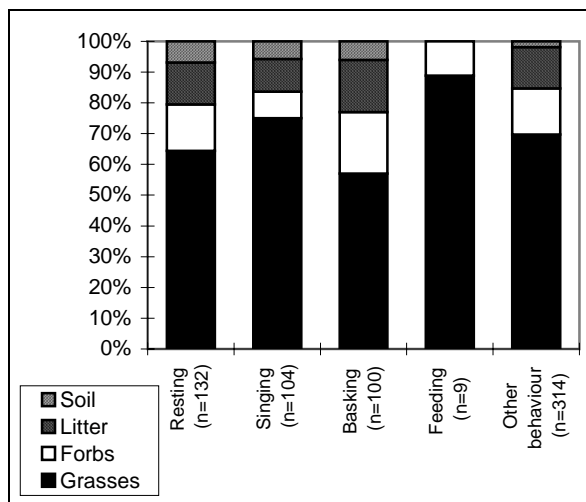


Fig. 2: Locations of *Ch. biguttulus* males during different behaviour.

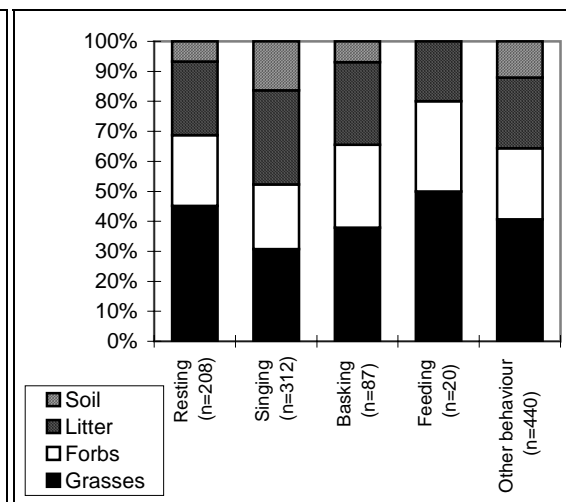


Fig. 3: Locations of *Ch. apricarius* males during different behaviour.

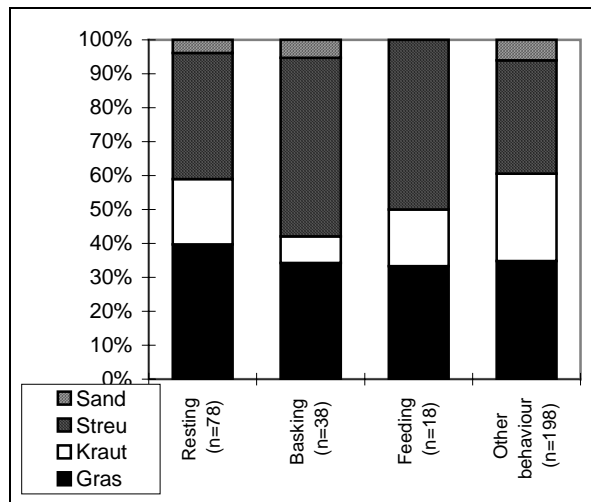


Fig. 4: Locations of *Ch. biguttulus* females during different behaviour.

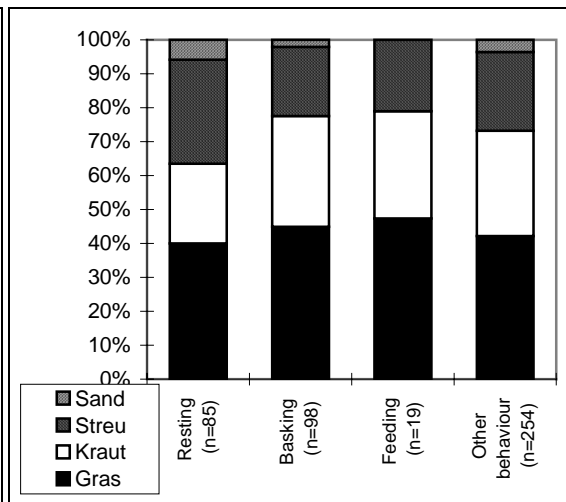


Fig. 5: Locations of *Ch. apricarius* females during different behaviour.

The sexual difference in location was more pronounced in *Ch. biguttulus* than in *Ch. apricarius*. While *Ch. biguttulus* females were found very common on litter, the males used fresh grasses more often. The higher values of forbs in *Ch. apricarius* were also observed during feeding behaviour. # specimens were observed, feeding on *Urtica dioica*. Both sexes of *Ch. biguttulus* were found during basking significantly more often on litter than during other behaviour. Singing males of *Ch. apricarius* were found more often on litter and open soil than during other behaviour. This was true especially during the courtship song. The resting males of *Ch. apricarius* were found at significantly higher locations than the females, which were resting and basking near the ground. During song, and especially during courtship song, the males were also located near the ground. In *Ch. biguttulus* the singing males were also located near the ground, although the resting females were found at similar heights as the resting males. Both sexes of *Ch. biguttulus* generally used higher strata than *Ch. apricarius* (Median), although the range utilized by *Ch. apricarius* was higher than in *Ch. biguttulus*. In contrast to this relations, the vegetation height was generally higher in the environment of *Ch. apricarius*. During all behaviour both sexes of *Ch. apricarius* were found more often horizontally than *Ch. biguttulus* (Figs. 8 & 9).

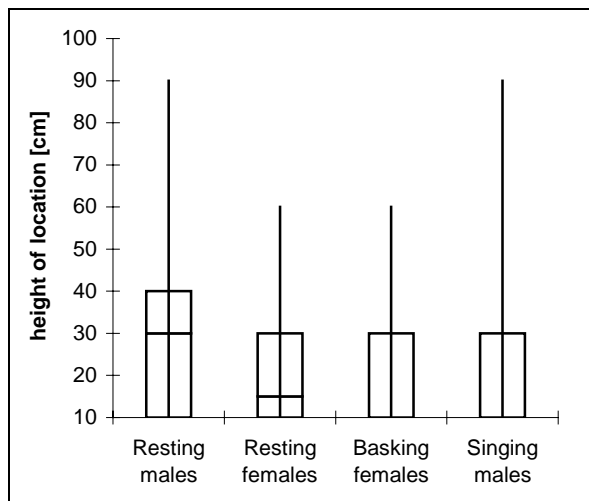


Fig. 6: Height of location of *Ch. apricarius* during different behaviour (Range, Q1, Median Q3; Last two columns: median = 0 cm).

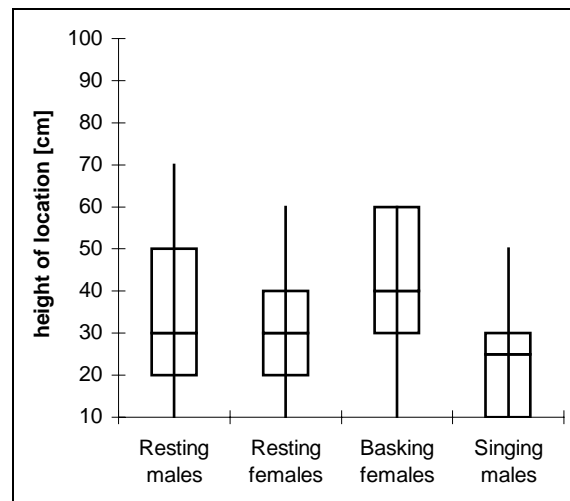


Fig. 7: Height of location of *Ch. biguttulus* during different behaviour (Range, Q1, Median Q3).

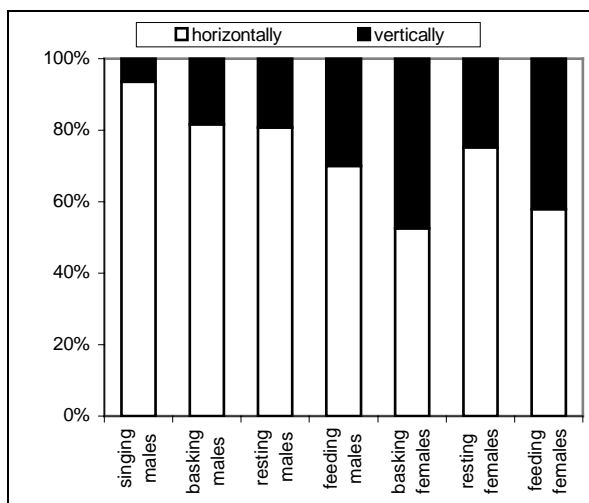


Fig. 8: Orientation of the sexes of *Ch. apricarius* during different behaviour

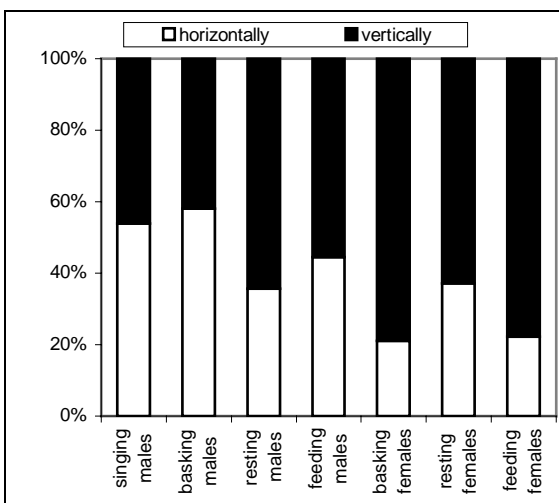


Fig. 9: Orientation of the sexes of *Ch. biguttulus* during different behaviour

Discussion

While Buchweitz et al. (1990) assumed that both species compete at fringes, our data shows that they utilize significantly different microhabitats. Moreover, *Ch. biguttulus* does not occur indigenous in the wet meadow area north of Bremen, although the species seems to immigrate here rather often. *Ch. apricarius* is able to persist at the edge of ditches, since it utilizes higher vegetation with higher forb content and also denser vegetation (Reck 1998). The species often thermoregulates horizontally on litter or leaves of forbs, high in the vegetation. This horizontal orientation is in clear contrast to Sanger's (1977) categories, in which phytophilous species should be orientated more often vertically. *Ch. biguttulus* occurs at patches with sparse and lower vegetation. It is much more dependent on grasses than *Ch. apricarius*. Due to their different microhabitats, the species either avoid competition or do not exhibit any competition at all.

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