The importance of hedgerows for hazel dormice (*Muscardinus avellanarius*) in Northern Germany

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Abstract

In the south eastern part of Schleswig-Holstein (Northern Germany), numerous nests of hazel dormice *Muscardinus avellanarius* could be found locally in hedgerows within a few hundred meters. It seems that the qualities of hedgerows and the proportion of woodlands in the immediate surroundings (≤ 500 m) of where dormice occur may influence local dormouse abundance. Given sufficient shrub diversity, dormice use hedgerows throughout the growing season and even establish viable populations in them: At least 12 woody plant species should occur in hedgerows to encourage hazel dormice.

**Keywords**: shrub diversity, surrounding landscape, Schleswig-Holstein

1. Introduction

The hazel dormouse (*Muscardinus avellanarius*) is the only species of dormice in Schleswig-Holstein, the most northern state of Germany. Only 10% of the State is woodland, therefore dormice are mainly dependant on the 45,000 km hedgerow network as dispersal corridors and habitats. In the past, studies about the habitat requirements of dormice in northern Germany have mainly been carried out in larger woodland areas (e.g. Quast 2001, Bollwahn 2003), so there is little knowledge about the demands of dormice in the linear, more or less isolated hedgerows. Also the current recommendations of the Federal Agency for Nature Conservation to monitor hazel dormice and to classify their conservation status with regard to the Fauna-Flora-Habitat Directive depend essentially on woodlands as habitats. Furthermore, little has been published on dormice in general for Schleswig-Holstein (e.g. Roessler 1952, Bollwahn 2003), so that knowledge about the dormouse and its distribution is still very new and incomplete. Thus, evidence of dormice in many hedgerows and woodland edges in the main distribution area (south eastern part of the state) raised numerous questions about the importance of hedgerows, woodlands and especially of the combination and densities of both habitat types for dormice.

Against this background, the principal aims of this study were (i) the detection of dormice in new locations and (ii) to determine the most viable hedgerow habitats for dormice by evaluating the composition of hedgerows in five study sites with different proportions of hedgerows and woodlands, as well as the densities of the nearby hedgerows and woodlands.
2. Material and methods

The underlying hypothesis of this study is that the presence and distribution of certain landscape structures (in this case woodlands and hedgerows) influences the occurrence and distribution of hazel dormice: An area with interspersed or nearby woodlands with a coherent network of hedgerows is classified as a ‘very suitable dormouse habitat’. Due to a decreasing proportion of woodland and hedgerow density, the classification decreases to ‘not suitable’. Thus, five study sites with different proportions of these landscape structures were identified using a Geographic Information System (ArcMap 9.3), so that the assumed different habitat suitability for dormice could be tested for these sites at different scales (Tab. 1). The parameters used to assist in the identification process include soil type, woodlands, hedgerow density, road density, railway networks, surface water bodies and rivers.

A total of 503 nest tubes were put up in June 2008, spaced at about 15 m intervals (Site A: 120, Site C: 150, Site D: 133 and Site E: 100). The nest tubes were retrieved at the end of November 2008 after five visits. In order to get an additional location with a high hypothetical habitat suitability for dormice, a further 196 nest tubes were also deployed at the end of September in study site B (Tab. 1., the results from this site were separately analysed). The nest tubes were inspected once every month. Within each of the five study sites all surveyed hedgerows and wood edges were mapped up to a length of ≤ 500 m; the percentages of the height and width classes [m], number and extent of gaps, the density of tree, shrub and herb layer [%], the degree of isolation, the total number of woody plant species was recorded. Additionally to this 9 components 19 further were recorded.

Based on a classification of hedgerows by Müller (1989), the quality of all mapped hedgerows was evaluated from 1 (very good) to 5 (poor); but due to the low number of hedgerows of the best quality 1 (very good), the categories ‘1’ and ‘2’ were merged into 1 + 2 (very good to good) (Tab. 2).

The landscape structure of the five study sites was then analysed within a 3 km and a 500 m radius, focusing on: hedgerow density in general, the density of the hedgerows of different qualities and proportion of woodland using a Geographic Information System (ArcMap 9.3). These sizes were based on published accounts of the longest measured dispersal distance of hazel dormice during the active period, as well as to the total distance travelled per night in hedgerows (Bright & MacPherson 2002, Schulze 1987 cited in Büchner 2008).

Tab. 1 The five study sites with different proportions of hedgerows and woodlands.

<table>
<thead>
<tr>
<th>Study site</th>
<th>Landscape structure</th>
<th>Denotation</th>
<th>Size [ha]</th>
<th>Assumed habitat suitability for dormice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thürk</td>
<td>very high hedgerow density, nearby woodlands</td>
<td>A</td>
<td>34.5</td>
<td>very high</td>
</tr>
<tr>
<td>Bebensee</td>
<td>high hedgerow density smaller nearby woodlands</td>
<td>B</td>
<td>85.9</td>
<td>high</td>
</tr>
<tr>
<td>Bad Segeberg</td>
<td>very high hedgerow density / without woodlands</td>
<td>C</td>
<td>29.5</td>
<td>medium</td>
</tr>
<tr>
<td>Gnissau</td>
<td>isolated hedgerows nearby woodlands</td>
<td>D</td>
<td>62.2</td>
<td>low</td>
</tr>
<tr>
<td>Krumbeck</td>
<td>isolated hedgerows /isolated, small scaled woodlands</td>
<td>E</td>
<td>37.7</td>
<td>very low</td>
</tr>
</tbody>
</table>
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### Tab. 2 Classification of the hedgerow qualities.

<table>
<thead>
<tr>
<th>Quality class</th>
<th>Condition</th>
<th>Shrub layer [%]</th>
<th>Damage (e.g. damaged earth bank)</th>
<th>Earth bank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1+2 'very good to good'</td>
<td>completely maintained, no gaps</td>
<td>80–100</td>
<td>no or negligible</td>
<td>≥ 0.7</td>
</tr>
<tr>
<td>3 'moderate'</td>
<td>completely maintained, moderately managed, no or few gaps</td>
<td>60–80</td>
<td>medium</td>
<td>0.3–1.0</td>
</tr>
<tr>
<td>4 'sufficient'</td>
<td>clearly incomplete and interrupted, vegetation is gappy and fragmentary</td>
<td>40–60</td>
<td>frequent</td>
<td>0.3–1.0</td>
</tr>
<tr>
<td>5 'poor'</td>
<td>preserved over long distances, but often fragmentary, not well maintained, tree lines, vegetation is gappy or absent</td>
<td>10–40</td>
<td>frequent</td>
<td>0.2–1.0</td>
</tr>
</tbody>
</table>

### 3. Results

Within the inhabited hedgerows of the five study sites we recorded between 0.1–2.0 free hanging nests per 100 m and 1.2–5.5 nests of hazel dormice per 100 m in the nest tubes. Breeding nests were found in shrubs as well as in the nest tubes. More than half of the free hanging nests (54%) were detected in blackthorn (*Prunus spinosa*), followed by bramble (*Rubus fruticosus agg.*); 3 were also in hawthorn (*Crataegus* sp.) and one within poplar (*Populus sp.*) and reed (*Phragmites sp.*) respectively. The most dormouse nests per 100 m were recorded in the study sites A and B, where 64% and 53% of the surveyed hedgerows were inhabited by hazel dormice. Site C was intermediate with 30% inhabited hedgerows. The least dormouse nests were registered in the study sites D and E (29 and 25%).

Nest tube occupation by the hazel dormouse was highest in October / November.

### 3.1. Importance of the hedgerow structure

The study area is characterised by blackthorn-hazel-hedgerows. Apart from these dominant species, bramble, honeysuckle (*Lonicera xylosteum*) and hawthorn are also common; with other woody species often intermixed. Based on a Principal-Components-Analysis, there were no significant trends concerning the detailed species composition of hedgerows and woodland edges for hazel dormice, because of the similar composition of sites.

Analysis of the relationship between the 28 recorded habitat components and the presence of dormouse nests resulted in a significant correlation regarding the number of woody plant species (Kruskal-Wallis-Test, \( p = 0.04 \), Min.: 9 Max.: 19), but only 1.5 plant species make the difference, whether dormice are present or not. Hence, at least 12 woody plant species should occur in hedgerows to encourage hazel dormice. There were no further significant correlations between characteristics of the hedgerows/wood edges and hazel dormouse occurrence. However, clearly more hedgerows within the lowest quality class 5 (poor) were unoccupied; there were no significant differences between the quality classes of hedgerows with and without hazel dormouse evidence (\( p = 0.1467 \)). In addition, the mapped woodland edges and hedgerows of category 3 (moderate) were more often inhabited than unoccupied by dormice (Fig. 1). The analysis of dormouse abundance and defined hedgerow qualities resulted in no significant correlations (\( p = 0.4709 \)).
3.2. Importance of the surrounding landscape structure

Analysis of the surrounding landscape structure resulted in a negative correlation between the hedgerow density of the larger scaled 3 km-buffer zones and the number of detected dormouse nests per 100 m ($R^2 = 0.661$): The higher the hedgerow density of the buffer, the fewer dormouse nests were recorded within the study sites. In addition, there is also a clear difference concerning the amount (m$^2$) of woodland per hectare in the surrounding area. The region around site D, with 24 m$^2$/ha has much more woodland than the other sites and the landscape around A and B is in comparison only sparsely wooded within a radius of 3 km (Fig. 2). Also, the majority of hedgerows in the larger scaled 3 km-buffer zone of site A, the site with the highest amount of dormice evidence, was classified as 5 (poor).
Within the smaller scaled 500 m-buffer zones of the study sites with the least evidence of dormice, sites D and E, the hedgerows classified as the worst are most frequent; furthermore, hedgerows of the best quality class are rare. On the contrary, the hedgerow network in the vicinity of sites A and B, the study sites with the most dormice evidence per 100 m, is characterised by hedgerows of the highest quality class, and those of the lowest category are uncommon. Due to the separation by a village, study site A is divided into two sub-areas (A1 and A2) in this smaller scaled analysis (Fig. 3). The surrounding landscape of sub-area A2, the site with clearly the most dormice evidence indeed shows the lowest hedgerow density (49 m/ha), but this buffer zone is also marked by the largest proportion of woodland area (9389 m²/ha) (Fig. 3). The site with the mean number of recorded dormouse nests, site C, is characterised by the highest hedgerow density within the 500 m-buffer (108 m/ha); but this is also the region with the lowest proportion of woodland (147 m²/ha). The surrounding area of site E, in which only a small number of dormouse nests could be found at the end of the active season, displays a relatively good hedgerow density, but the percentage of forest is comparatively very low (Fig. 3).

4. Discussion

The results of this study show that at least 12 woody plant species (including tree species) have to occur in hedgerows of Schleswig-Holstein to provide a suitable dormouse habitat. According to several British surveys (e.g. Bright & MacPherson 2002, Bright & Morris 2006), hedgerow shrub diversity was also an important correlate of dormice density, although other components like hedgerow height were also correlated with dormouse abundance. Chanin & Woods (2003) observed for example, that on average 12.9 woody species were found in occupied hedgerows. The number of recorded hazel dormice nests per 100 m confirms the prior assumption of habitat suitability for dormice in the five study sites. The negative correlation between the hedgerow density of the larger scaled 3 km-buffer zones and the

Fig. 3 Hedgerow density (m/ha) and proportion of woodlands (m²/ha) within the 500 m-buffer zones of the five study sites. Numbers: Evidence of hazel dormouse (*Muscardinus avellanarius*) per 100 m in core site.
number of recorded dormouse nests implies that neither the presence of larger woodlands, nor a high hedgerow density have a great influence on dormice abundance sampled in all five small specific localities between 30 and 86 ha. On the other hand, the smaller scaled analysis of the landscape structure within a 500 m-buffer zone seems to have a greater influence on local dormouse populations. These results indicate a correlation between dormice occurrence and the qualities of the surrounding hedgerows. Perhaps the addition of a more detailed differentiation of the buffer zones would lead to more significant results, for example by taking fragmentation by roads and natural barriers such as rivers and fens into account.

However, these results also support the assumption that a well-preserved, coherent hedgerow network between (otherwise isolated) woodlands is important for an implied exchange of individuals and dormouse migrations. Furthermore, the evidence of breeding nests indicates that hazel dormice reproduce successfully in some of the hedgerows in Schleswig-Holstein.

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6. References


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