

The effect of forest canopy gaps on the spatial distribution of Hazel grouse (*Tetrastes bonasia*) during the pre-laying period

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Canopy gaps introduce heterogeneity in the forest structure and create ecological conditions differing from those of the surrounding forest, which results in greater vegetation diversity. Direct exposition of ground vegetation within canopy gaps to sunlight results in plant phenology shifting earlier and faster development compared to surrounding forests. Canopy gaps could thus represent important food resources for Hazel grouse (*Tetrastes bonasia*) during the pre-laying period in early spring, when hens have high energetic requirements but few resources available. This study aimed at testing the hypothesis that food resources are more abundant in canopy gaps and that individuals in early spring are located in close vicinity of those gaps.

First, we used LiDAR data to identify canopy gaps in two zones of the Vallée de la Trême in Switzerland and quantify the area of sun-exposed ground vegetation within those gaps. We then investigated the temporal dynamics of the sun-exposed surfaces throughout the breeding period of the Hazel grouse, i.e., from March to July. The gap surface exposed to direct sunlight increased until the sun reached its maximal azimuth at the summer solstice (21st of June). Large gaps constituted the majority of sun-exposed surface during the entire breeding period. Only gaps larger than 100m² were attractive at the beginning of the breeding season. The smaller the gap was, the lower the proportion of sun-exposed surface. Small gaps became attractive for Hazel grouse in late May.

In a second step, we investigated the abundance of food resources during the pre-laying period. We quantified the abundance of five important food resources in three different forest structures, namely within the surrounding forest, at the forest edge (ecotone) and within canopy gaps. The closed forest hosted few resources. Feeding trees, willow (*Salix* sp.), rowan (*Sorbus aucuparia* L.) and hazel (*Corylus avellana* L.), were principally found within the ecotones whereas ground vegetation (bilberry *Vaccinium myrtillus* L. and herbs) were predominantly found within canopy gaps. Canopy gaps and adjacent forest edges gathered important food resources for Hazel grouse during the pre-laying period (March–April).

Finally, we collected indices of the species' presence along linear transects to assess whether individuals were located in the direct vicinity of canopy gaps in early spring. Indices of the species' presence were significantly closer to canopy gaps than expected under the null hypothesis of random distribution. We concluded that canopy gaps had an attractive effect on Hazel grouse and impacted its distribution during the pre-laying period.

Hazel grouse monitoring usually occurs in winter, when snow cover facilitates field prospections. However, suitable snow conditions become less frequent across the distribution range of the specie and adaptation of the current method is necessary. Our results suggest that prospections could focus on canopy gaps and adjacent forest edges in early spring. Further studies are needed to confirm the attractive effect of canopy gaps on Hazel grouse in other habitat types. It would also be essential to investigate if the specie takes advantage of canopy gaps during the rest of the breeding period, i.e., nesting and brood rearing.

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