RESEARCH PROJECT 2

Habitat and space use of common buzzards near and in windfarms

student: Rok Jesenko, S3744388

supervisors: Tonio Schaub, Raymond Klaassen

ABSTRACT

Oftentimes, predators prefer habitats with higher prey availability, which in return increases their fitness. Prey habitat selection was reported in many animals, among which are also raptor birds. In our study, we were interested if the abundance of common vole (*Microtus arvalis*) determines the habitat preference of Common buzzards (*Buteo buteo*). Voles are a big part of buzzard's diet so we hypothesized that buzzards will more frequently select habitats with higher Common vole abundance. With an attached GPS tracker we identified home ranges of 6 buzzards, that were inhabiting farmed habitats (winter wheat fields, empty fields, grasslands, grasslands with cattle) and non-farmed habitats (road-verges). Within each habitat of each home range, we estimated a vole abundance and compared it with Ivlev's electivity index which indicated if a bird was selecting or avoiding certain habitats within its home range. Derived results were in favor of our hypothesis. Voles were the most abundant in grasslands and road verges and these are also the habitats buzzards in general selected for. Further research will be directed towards the importance of perching sites for habitat selection and the applicability of the alternative prey hypothesis. However, current conclusions are relevant for further implications in conservation efforts.

Keywords: habitat selection, common buzzard, common vole, Ivlev's electivity index

INTRODUCTION

Habitat is the main determinant of the abundance and distribution of organisms and is consequently the main focus area for the majority of conservation efforts. (12) An animal's habitat must provide multiple ecological services, each of which can potentially affect how the habitats are selected. (11) Habitats selection itself, refers to a process whereby individuals preferentially use or occupy, a non-random set of available habitats (1) For predators, the availability of their prey should be an important factor in their habitat preference since the prey abundance increases their overall survival and reproduction success. (19, 20)

The overall goal of the study was to investigate if a prey abundance can in fact determine the predator's habitat selection. The model organism used in our research is the Common Buzzard (*Buteo buteo*), a widespread European raptor bird. Common Buzzards are generalist predators, meaning that they can make use of a variety of different prey types and they can thus thrive in a wide variety of environmental conditions. They have several alternative prey species between which they may »switch«, depending on which prey species are currently most abundant. Their diets is variable, consisting off different species of small mammals like voles, shrews or forest grouse, hares and small birds. (3) However, *Microtus* voles have been reported to represent the majority of their diets and are regarded as their main prey. (3) In our study we focused on Common voles (*Microtus arvalis*).

Prey habitat selection was already observed in other species of raptors. (6,7,21) However, a limited number of studies focused on the effect of Common vole abundance on habitat selection of Common Buzzards, despite the fact that it is such a common bird. Does the abundance of common vole (*Microtus arvalis*) determine the habitat preference of Common buzzards (*Buteo buteo*)? Since voles represent a big portion of the buzzard's diet, we hypothesized that the common buzzard more frequently selects habitats with higher Common vole abundance.

METHODS

Study area

The study was conducted around two wind farms in Meeden and Delzfijl in the northern Netherlands. Here, the majority of the land is cultivated with crops (mainly winter wheat, sugar beets, and potatoes) and grassland. Agricultural fields are interspersed with patches of temperate broadleaf and mixed forests.

Buzzard tracking

Six adult Common Buzzards were captured near the nest using a mist-net and a stuffed eagle owl and quipped with GPS-GSM loggers (24 g, brand Ornitela, model OrniTrack-E25B-4G-C3). One of the buzzards was caught with an alive eagle owl. GPS trackers were firmly

attached using a full-body harness made from 6-mm-wide Teflon ribbon strings. Tracker and harness combined weighted 27 g. Data were remotely downloaded from the trackers using the *UvA-BiTS* antenna system. The GPS trackers were programmed to record positions every 15 minutes. In addition to this basic program, hourly blocks of high-resolution data were collected. The latter data were downsampled to 15-minute intervals to match the basic data. In this study, we only used the data from the year 2022.

Home ranges and habitat selection

The data were used to determine the home ranges for each buzzard. The Minimum Convex Polygon (MCP) was calculated (v4.0.5; R Development Core Team 2021). These home ranges were intersected with a spatial land use map (TOP10, BRT 'basisregistratie topografie'). (23) This map distinguishes between buildings, grass, water, farmland, trees and bushes, swamps, roads, and other terrains. Subsequently, we manually mapped the crops.

Once the GPS tracker is in place, it records its position every 15 minutes. This way we obtained low-resolution data, with which we were able to define a home range of each buzzard. With satellite images and fieldwork, we identified the types of habitats within the home ranges of buzzards. In general, we divided the habitats into farmed land and non-farmed land. We defined farmed land, as land that is getting used for agriculture, It included fields, that were further divided between grasslands fields, grasslands with cattle, winter wheat fields, and empty fields. Verges, located next to fields and roads, represented non-farmed land habitats. Subsequently, we manually mapped the crops on the fields, distinguishing between ungrazed grasslands, grasslands with cattle, winter wheat, and empty fields. Empty fields included fields that were just plought or seeded, for which the crop type could not be determined during the survey. Verges, located next to fields and roads, represented non-farmed land habitats. Forests were also treated as non-farmed land but we decided not to monitor them as the common voles do not live in the forest.

Data analysis

The Ivlev's electivity index was used to quantify the habitat preference of Common Buzzards. The ivlev's electivity index is calculated by $I = (U – A) / (U + A)$, where U = habitat use (percentage of GPS points in that habitat) and A = habitat availability (percentage of the area of that habitat within the home range). The Ivlev's electivity index is calculated separately per habitat type, and ranges from -1,0 (habitat completely avoided) to 1.0 (habitat exclusively used). An index of -0.0 means that the habitat is used in proportion to its availability. Based on Ivlev's electivity index we also distinguished the fields and verges between »non-used« (negative index) and »used« (positive index).

Analyses and graphs were made in R (v4.0.5; R Development Core Team 2021) with significance level a = 0.005, and in Microsoft Excel. For data visualization, we used the violin plot since it also indicated the distribution of numeric data, in our care the vole index. To test if there was any significant difference between used and not-used fields and verges a Mann-Whitney U test was performed.

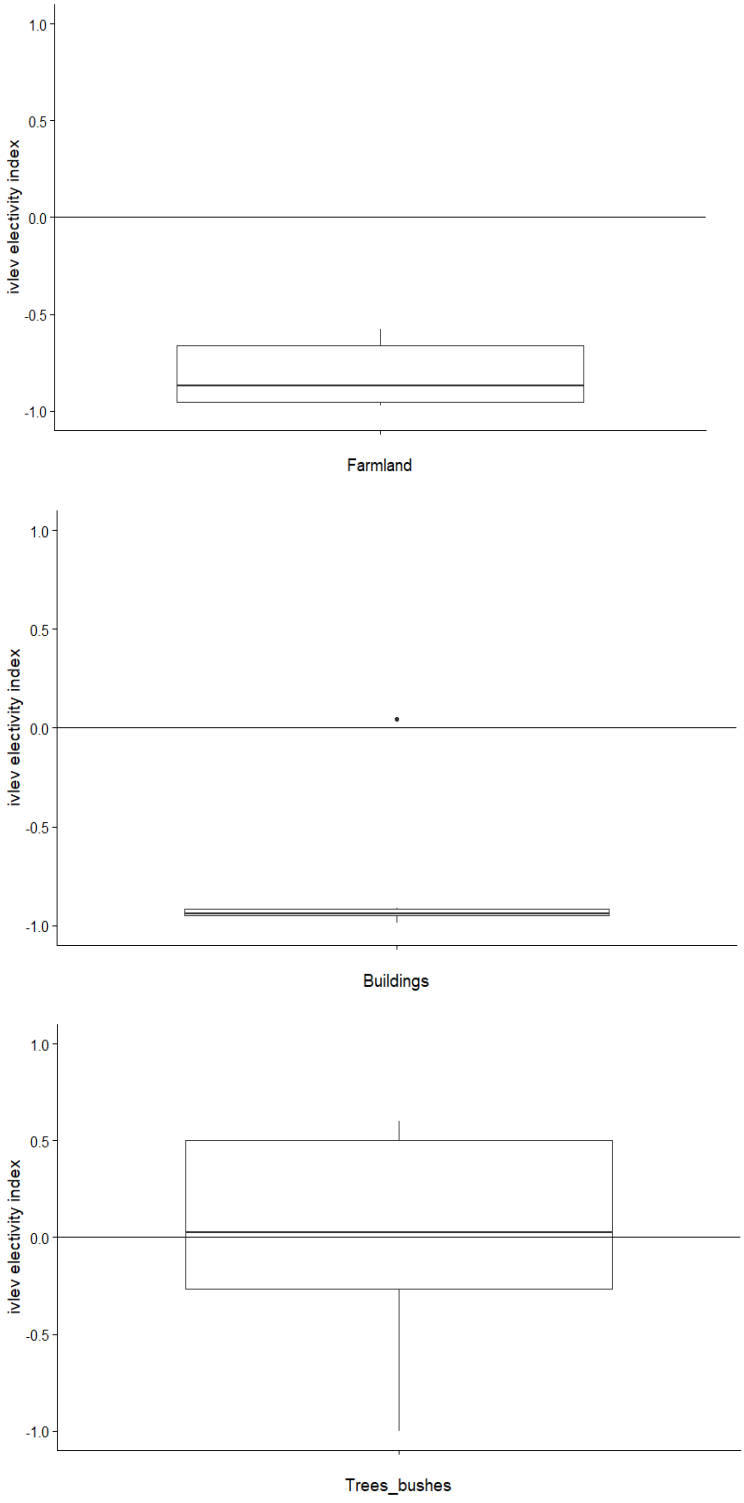
Vole count

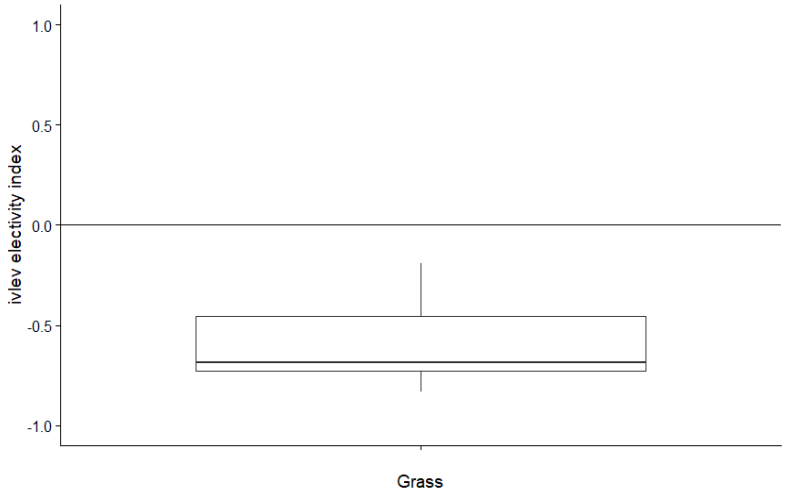
Within each home range of each buzzard, we monitored vole abundance on six fields and in six verges: three fields and three verges that the buzzards was using, all within its home range. For each field or a verge, three transects were surveyed. A transect was approximately 100 meters long and consisted of 10 points. At each point, we laid a 25 x 25 frame at the ground and determined whether traces of voles were present. Signs of voles we looked for were burrow entrances, droppings and food leftovers. (25) We marked the presence of vole sings with »yes« or »no«. Sample sizes differ between the field: grassland with cattle (n=2), empty field (n=5), grass field (n=9), and wheat field (n=20) and road verges (n=36)

RESULTS

a) Habitat use and habitat selection of Common Buzzards

In the overall habitat selection, buzzards only selected trees and bushes (positive Ivlev electivity index) out of all 8 habitats they could choose from. The rest they avoided. (Fig.1)




1.0
0.5
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ivlev electivity index
Grass


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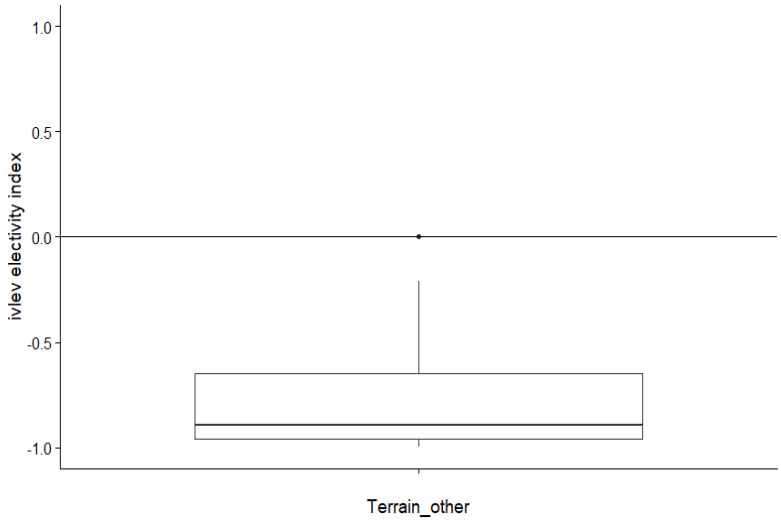
ivlev electivity index
Swamp


1.0
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ivlev electivity index
Terrain_other

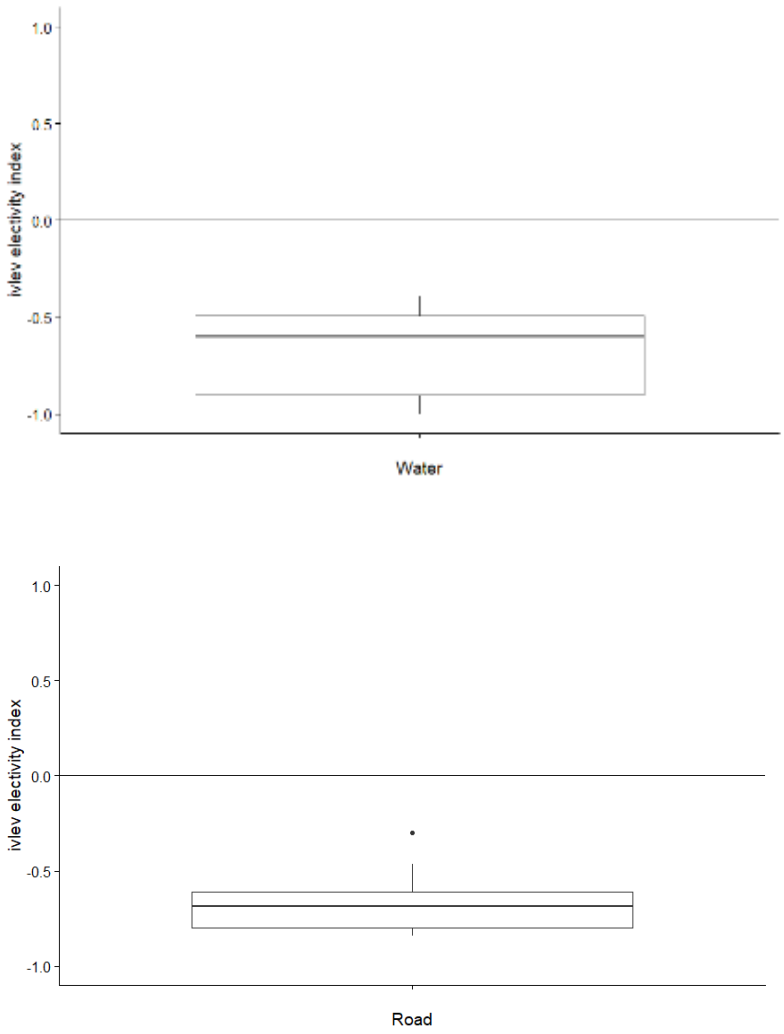

Figure 1: Ivlev electivity index (y-axis) in different available areas (x-axis) the buzzards (n=6) could select or avoid

When it comes to only farmland, it is seen that ungrazed grassland and empty fields were used according to availability (i.e. Ivlev's index of 0.016 and 0.001, respectively), whereas the other field types, including grazed grassland, were avoided (Ivlev's index varying between -0.229 and -0.564) (Fig.2)

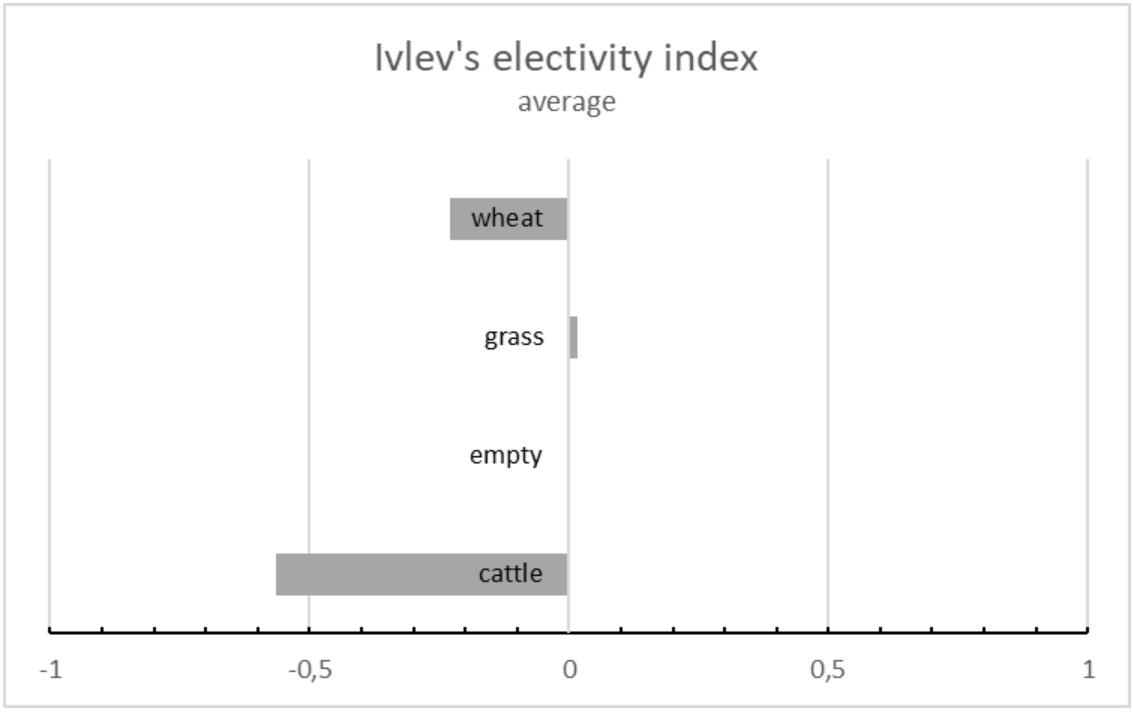

Figure 2: Ivlel's electivity index in farmed habitats

b) Vole abundance

From the 216 transects, we obtained 2160 data points. Out of farmed habitats (grassland with cattle, grassland, winter wheat field, empty field), the voles were present only on grasslands and road verges. We did not find any vole traces on grassland with cattle, empty fields or wheat fields. (Fig. 1)

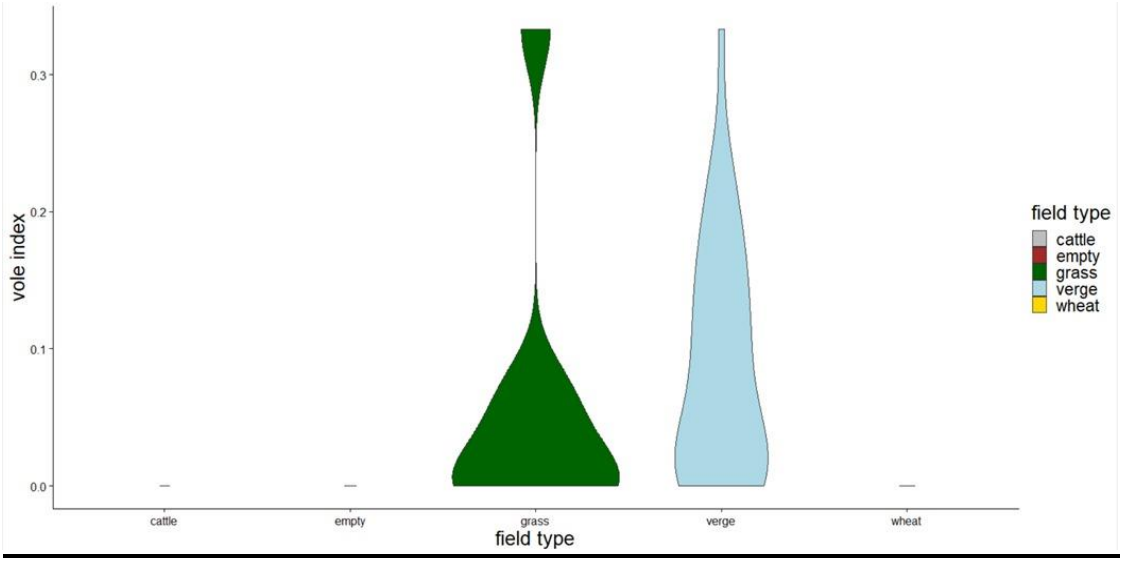

Figure 3: Vole index (y-axis) on different habitats (x-axis) – grass field with cattle (left), empty fields, grasslands, road verge, winter wheat field (right). Sample sizes differ between the field: grassland with cattle (n=2), empty field (n=5), grass field (n=9), and wheat field (n=20).

Voles were generally present in the verges, no matter if the buzzards were using them or not. There was no significant difference in vole index between the verges buzzards selected (used), and those that they avoided (non-used) (p = 0.1923).

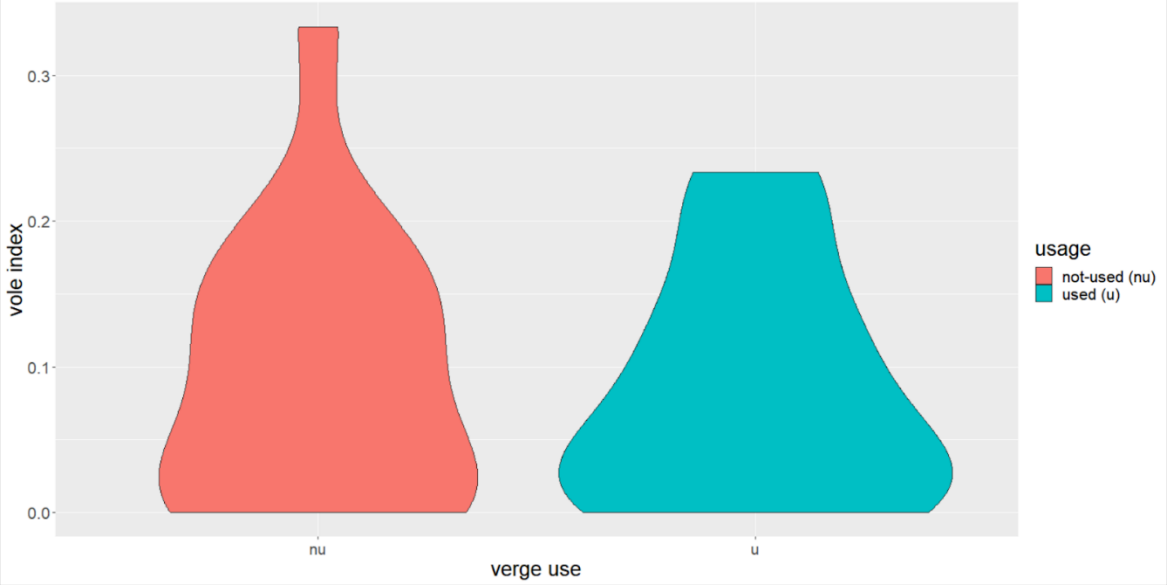

Figure 4: Vole index (y-axis) and non-used (left) termed »nu« and used (right) verges termed »u«

There was a significant difference between the non-used and used fields. Voles were present only in the fields buzzards are using. (Fig. 2)

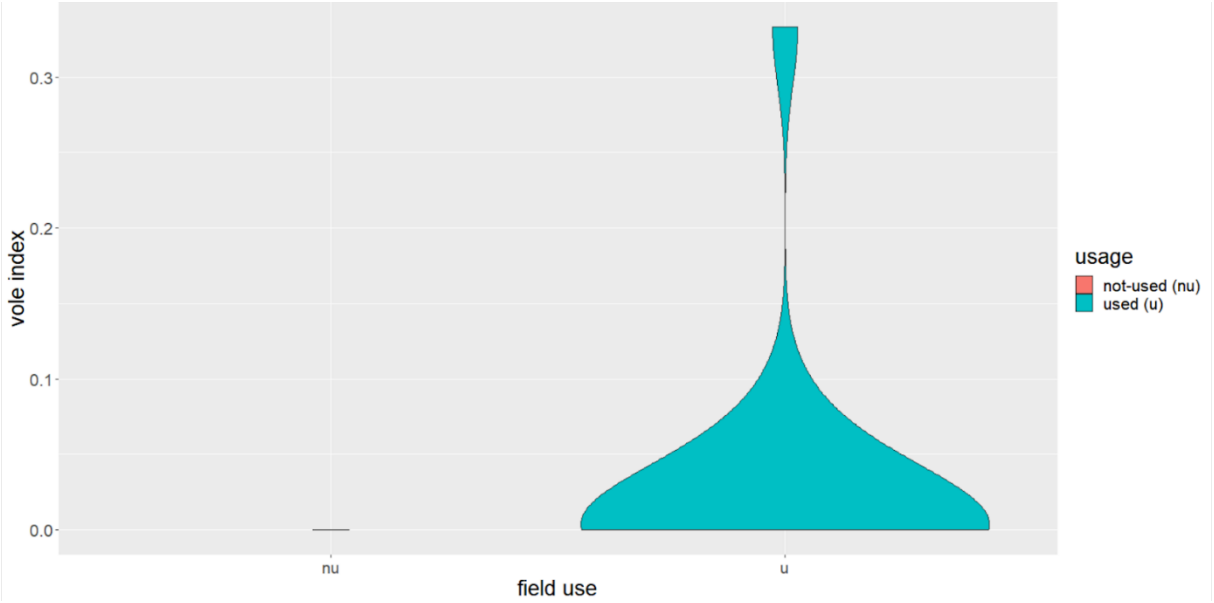

Figure 5: Vole index (y-axis) on non-used (left) and used (right)

DISCUSSION

The overall goal of the study was to see if prey abundance determines the predator's habitat selection. We were interested if this holds true for Common Buzzards and Common voles, which are considered to be their main prey. (3) Little is known about the habitat use of Common Buzzard. Even though this raptor is an abundant species, the numbers are decreasing due to climate change and changes in land use. (22) Therefore, understanding the habitat use and spatial distribution of these birds is crucial for conservation management. To obtain more insight into that, we combined the GPS tracker data from 6 Common buzzards with Common vole abundance estimates. We hypothesized, that buzzards will more often select those habitats that have higher vole abundance.

a) Habitat use and habitat selection of Common Buzzards

On a larger scale, the buzzards clearly preferred forest. When estimating the Ivlel electivity index for different habitats (Fig. 1) the buzzards could choose from, the trees and bushes were the only ones the buzzards selected for (positive Ivlev electivity index) and they avoided the rest. There is a high chance this result is biased since the buzzards are nesting, sleeping, feeding, and perching in the forest. Consequently, there are more GPS data points obtained from the forest. Since common voles are not present in the forest, the Common Buzzard has to prey on something else, but we did not estimate the prey availability in the forest. According to the alternative prey hypothesis Common buzzards are able to shift their diet. (3) APH predicts that, in the years when the main prey species decline, generalist predators can shift their diet to alternative prey and thus cause its decline. (8) This way, the common buzzards are not dependent on any particular prey type (4) Nevertheless, *Microtus* voles are their main prey, but water voles, shrews, pheasants, hares, and small birds are their most important alternative prey. (3) We observed all of these species during the fieldwork within the home ranges of buzzards. Any deviation of buzzards' habitat preference away from habitats with high vole abundance could be explained by an alternative prey hypothesis. Further research would be needed. Overall, the habitat selection of Common Buzzards at this scale is not in accordance with our hypothesis. At this scale, the Common Buzzards do not favor the habitats where Common voles are abundant.

When comparing only the fields, certain individuals selected the grasslands and avoided other fields. (Fig. 2) This corresponds with the vole abundance since it was only reported on the grasslands. The result at this scale is in favor of our hypothesis since it seems that Common vole abundance determines the habitat preference of the Common buzzard. Grass fields have an Ivlev's index value of 0.016, so they are also used in proportion to their availability. Grass fields with cattle seem to be strongly avoided but we only sampled two of them. As expected wheat fields with no signs of voles are also avoided (-0.23). Empty fields have a neutral Ivlev's index value since they are used in proportion to their availability. This is unexpected as there were no voles present in the empty fields. Previous research already pointed out that habitat selection of some raptor species whose diet consists predominantly of a single species conforms to the habitat of their prey. (8) The habitat of the Verreaux Eagle is often described in terms of the African Hydrax habitat, namely rock outcrops (21). Similar prey habitat selection was observed in Ferruginous Hawk and its principal prey, the Townsend's Ground

Squirrel (6). Despite the fact that grass fields are the only field with signs of voles, they are not being actively selected for by Common buzzards.

b) Vole abundance

The voles within the buzzard's home ranges were in general almost only exclusively present in the field verges and grasslands. In general, voles occur in stable habitats with not a lot of perturbation. Therefore, intact field verges and non-ploughed grassland represents key habitats for voles. (15,16) We did not find any voles on the grasslands with cattle and freshly plowed empty fields. We also did not find any voles on winter wheat fields. Previous studies pointed out towards synchronous cyclic pattern of the population fluctuations in several vole species (10). This means that there is an alternation of years with high and years with low common vole abundance. We do not know if the vole index we observed during our research indicated a year with high or low vole abundance, but it does highlight the importance of the previously mentioned alternative prey hypothesis.

When comparing the vole abundance in the verges that are being used by buzzards and those that are not being used by buzzards, we did not observe any significant difference in the vole index. (Fig. 4) On the other hand, when comparing the fields, voles were only present in the fields used by a buzzard, but not in those that buzzards are not using. (Fig. 5) The second observation is in favor of our initial hypothesis, that the buzzards will select (use) the habitats where voles are abundant and avoid (not use) those with no voles. However, we would expect the same for the verges but there the trend differs.

We can speculate that the habitat selection of Common buzzards there also depends on the availability of the perching site. This is something that we could have recorded from the start of the study, but we did not. The perching site could be a tree branch, fence, wall, or street light. Unlike some other raptors, the buzzards hunting technique is often to sit on a perching site that overlooks the area with potential prey. This might be an especially crucial hunting technique when looking for voles in high and dense vegetation often associated with verges. That could explain why the buzzards do not select some verges, even though the voles are present there. Maybe is the presence of a perching site more crucial predictor of Common buzzards habitat selection than the actual Common vole abundance.

CONCLUSION:

The overall goal of the study was to see if a prey abundance, in our case the Common vole, determines the predator's habitat selection, namely the Common buzzard. In the end, we did find evidence indicating that the Common vole abundance does in fact determines to some extent the habitat selection of Common buzzards. Voles were most abundant on grasslands and this habitat is also the one habitat buzzards selected the most. We are acknowledging that further research on certain additional variables should be executed. Particularly the availability of a perching site and alternative prey hypothesis.

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